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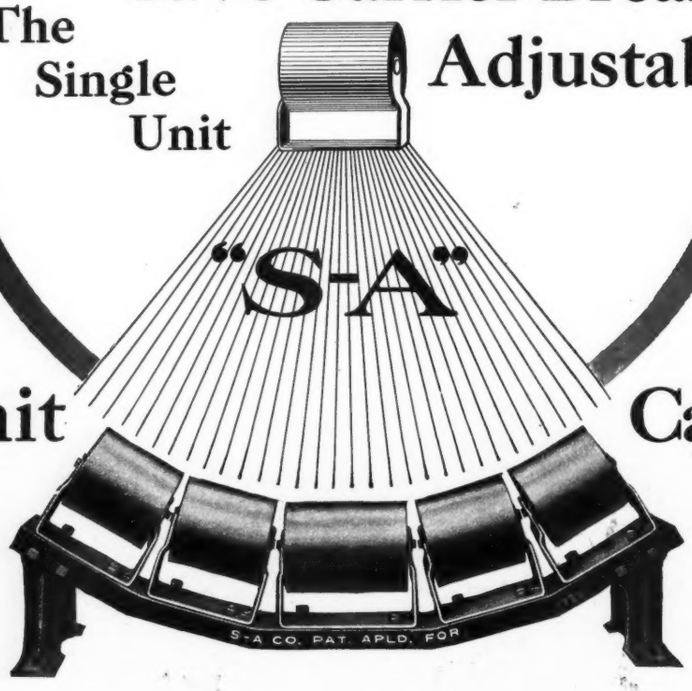


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# Silver-Tin Mining in Bolivia

By Joseph T. Singewald, Jr.,* and Benjamin Le Roy Miller†

*SYNOPSIS—The three most important silver-tin mines of the Oruro district, all working the same system of veins, are the Socavon, the San José and the Itos. Low-grade ore used for stope filling centuries ago is now handled at a profit. Metallurgical treatment comprises chloridizing roasting and leaching of copper and silver, followed by concentration of residues to recover tin.*

The ore deposits of the Oruro Hills, Bolivia, have features of more than usual interest, due to the fact that they afford the best illustration known today of this type of silver-tin ore deposits. This association of silver and tin, which is so common in Bolivia and so unusual elsewhere, has always made these Bolivian deposits peculiarly attractive to students of ore deposits. The ores mined at Oruro are particularly interesting for the reason that the ratio of silver to tin is higher than in most of the ores of this type now being mined, and because the silver and tin minerals are so intimately associated in much of the ore.

The most famous of all the old silver districts of Spanish colonial days in South America was Potosi. Next to it in fame came Colquechaca and Oruro. Potosi is now principally a tin producer, Colquechaca lies idle, while Oruro is still essentially a silver producer. The silver ores of these Oruro Hills were known to the natives before the arrival of the Spaniards, but upon the death of the Inca Atahualpa the Indians destroyed all evidences of their work in order to hide the deposits from the Spaniards. In 1575 the mines were rediscovered by the Spaniards and for a long time rivaled in richness those of its more illustrious competitor, Potosi. In the seventeenth century the City of Oruro grew to be a town of over 75,000 inhabitants, and the small group of hills rising above it was dotted with hundreds of mines.

FIG. 1. CITY OF ORURO, LOOKING FROM THE HILLS ACROSS THE "ALTIPLANICIE"

During the following century the rich silver chlorides near the surface were approaching exhaustion and the production of the mines was decreasing, when in 1780 an Indian uprising put an end to mining through the assassination of all the Spanish miners. Early in the next century when A. D'Orbigny visited the place, he found only one

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tin vein near the summit of the mountain being worked, and the site of the once prosperous city was occupied by a mere village. In 1861 the silver production scarcely amounted to 30,000 oz., but a slow revival was setting in and the output continued to increase for some years afterward. In 1885 the present Chilean company known as the Compañía Minera de Oruro was founded and purchased the Socavon de la Virgen. This mine increased its output from 150,000 oz. in 1886 to 800,000 oz. in 1891, with a total for that period of 3,333,000 oz. About the same time another Chilean company purchased the Itos mine near the west end of the mineralized belt, which is now also the property of the former company, and for several years produced 400,000 oz. silver annually. Between the two mines just mentioned lies the San José mine, which was then owned by a Bolivian company, but which is now the property of the Compañía Minera de San José, a Chilean company. The Compañía Minera de Oruro and Compañía Minera de San José now controls the district.

In the year 1891 the total output was 1,800,000 oz. of silver. Since then the depreciation in the price of silver and the neglect of silver mining in Bolivia attendant on the development of the tin-mining industry have seriously affected the production, so that in 1915 it amounted to only 780,000 oz. Nevertheless, this is one-third of Bolivia's silver output and ranks the district second among her silver-producing districts, being excelled only by Huanchaca. At the same time it has become an important tin district and the same mines are producing over 1,000 tons of tin concentrates annually, which have a value about equal to that of the silver they yield.

The Oruro Hills are a group covering an area of about 4 sq.mi. rising above the "altiplanicie," or high plateau, of Bolivia near its eastern edge, on the west side of the Antofagasta & Bolivia R.R. about 233 km. south of La Paz. They constitute a western outlier of the Cordillera Oriental, or Cordillera Real, that borders this plateau on the east. The elevation of the plateau is a little over 12,000 ft., and the hills rise 1,200 ft. above it.

### General Geology of the Oruro District

The main mass of the hills is made up of igneous rock intermediate in composition between quartz porphyry and dacite, which frequently carries large phenocrysts of orthoclase. On the southern side and on the west slope are numerous areas of dark-colored shales which are part of the series of early Paleozoic shales that are so widespread in their occurrence in the main range. In the mine workings these shales are frequently encountered as isolated blocks in the igneous rocks that probably represent pieces broken off as the intrusion forced its way through the shales.

At the foot of the eastern slopes of these hills lies the City of Oruro, seen in Fig. 1, which, with a population of 25,000 or more, has become the second most important commercial center of Bolivia. For many years it was the terminus of the Antofagasta & Bolivia R.R.; in 1908 this road was extended to Viachi, making connection with La Paz and the Ferrocarril Central del Perú, giving a second outlet to the Pacific at Mollendo. The opening of the Arica-La Paz line in 1913 gave Oruro a third outlet. In addition there is the branch line to Cochabamba, so that aside from being the center of an important silver- and tin-producing district, Oruro is a place of considerable industrial importance.

The mineralized area includes the northern part of the hills, and the richest portion is a belt extending diagonally across them from Oruro in a direction a little north of west, which is marked on the surface by countless old openings and dumps, evidences of the extensive activities of years gone by. There are now three important mines located on this belt, known from southeast to northwest as the Socavon, the San José and the Itos, which are all working the same system of veins, the most important and persistent of which is the vein known as the Purisima in the Socavon ground. The country rock is almost entirely the igneous rock, but more shale is encountered in the Itos mine than farther east.

The Socavon mine is located on the east slope just above the City of Oruro; in fact, the main level of the old workings known as the Socavon de la Virgen enters the hill at the offices of the company in the town itself. This is a crosscut to the Purisima vein. The old workings extend to a depth of 75 m. below this tunnel, but the newer workings reach a depth of 150 m. more. An incline from the surface cuts this level a little to the north of where the crosscut reaches the vein and continues to the 125-m. level below it. From the latter level a vertical winze has been sunk 100 m. at the junction of the Inch and Nueva veins.

The Purisima vein has a strike N 15° W and dip 45° to 70° west, and branching from it are several subordinate

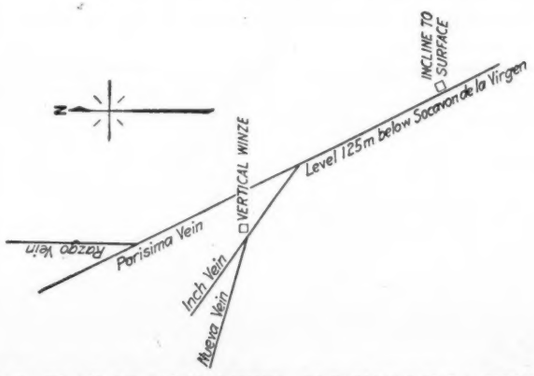


FIG. 2. PLAN OF 125-M. LEVEL, SOCAVON DE LA VIRGEN MINE

veins, the more important being the Nueva, Inch and Razgo, the relative positions of which are indicated in Fig. 2. The veins are fissure fillings with frequent inclusions of fragments of the wall rock. Only occasionally is there a well-defined parting, but for the most part the veins are frozen to the walls and at some places there has been replacement of the wall rock so that the vein material gradually merges into the barren country rock.

### Vein Character Altered at Slate Contact

The Razgo vein runs into slate and changes its character completely at the contact, for whereas in the porphyry it is a well-defined vein rich in tin, in the slate it splits up into a number of minute stringers less than 1 cm. wide, which carry no tin or iron sulphides, but consist entirely of the argentiferous sulphantimonides carrying 1% to 2% silver. Otherwise the veins are quite uniform in character and filling. The average width is 4 ft. and the maximum 20 ft. On the level of the Socavon the ore is practically continuous, but it breaks up into three nearly vertical oreshoots the stope lengths of which are decreasing in depth.

The main mass of the vein filling in the present workings consists of the iron sulphides with but a small percentage of nonmetallic gangue. A little quartz occurs, but no boron- or fluorine-bearing minerals were seen. Next in prominence to the iron sulphides are cassiterite and the silver-bearing minerals. The cassiterite is usually of a light-brown or yellow color and for the most part massive or finely crystalline. The principal silver minerals are tetrahedrite and jamesonite. The former occurs massive in bunches and stringers in the pyrite, the latter commonly in thick tufts of acicular crystals or fine needles in druses in the pyrite. This manner of occurrence is equally characteristic of the lowest and of the higher levels. The tin and silver minerals occur in part separate and distinct in the pyrite, and in part very intimately intermingled. It would seem that they must be essentially contemporaneous, with the silver-depositing stage showing a tendency to continue just a little later than the period of tin mineralization. There is no sphalerite and only a small quantity of galena in the ore.

### Low-Grade Stope Filling Now Mined at Profit

To a variable depth of 50 to 100 m. the sulphide ores have undergone oxidation, and it was the rich accumulations of horn silver in this oxidized zone that were sought in the early history of the camp. Now only the leaner parts are left, and the ores after sorting do not average more than 5 to 6% tin and 8 oz. silver. Immediately below the zone of oxidation was formerly a zone of rich sulphides which is now practically exhausted. This zone furnished picked ore running several thousand ounces per ton. It is succeeded by the zone of primary ores in which the silver content is much lower. In years gone by no ore carrying less than 150 oz. silver was profitable, so that many of the old stopes were filled with material that can now be worked, and except for the ore from the new deeper parts of the mine the present output comes from lean pillars that were not removed, and from the old filling. This filling sorted down to 1 in 7 yields a product that averages 4 oz. silver and 1½% tin. It has become so indurated and cemented as a result of the chemical decomposition it has undergone that it stands of itself and can be mined in the same way as the untouched parts of the vein. In fact, the oxidation of the sulphides is going on at such a rate that the air in some parts of the mine is extremely irritating to the mucous membrane of the throat and lungs, and at the bottom of the vertical shaft the temperature is 75° F. The crude ore is subjected to hand sorting, reducing 3 tons to 2 tons, and the sorted material averages 35 oz. silver, 2 to 3% tin and about 30% sulphur. In addition it carries ½% copper, which must occur chiefly in the tetrahedrite.

### San José Deepest Bolivian Tin Mine

On passing into the San José territory the Purisima vein takes a westward swing, and by the time it reaches the Itos mine it has an east-west strike. The mine is being worked by the Itos tunnel, which is 76 m. above the Socavon de la Virgen, but on the opposite side of the hills. Going down from it is a 300-m. shaft at whose bottom is an 80-m. inclined winze, which makes this the deepest tin mine in Bolivia and one of the deepest of Bolivian mines. In the levels of the incline, the vein enters a mass of slate in which it splits up, but on passing out of the slate into the porphyry on the opposite side again assumes its original character. Some very rich silver ores have been encountered in these lowest levels, running as high as 500 to 600 oz. silver, and the rich silver ores of this mine carry 150 to 300 oz. silver. In these same levels patches of almost pure cassiterite are found. After having gotten below the zone of secondary sulphides there seems to be no further impoverishment with depth down to the present limits of the workings. Some excellent specimens of "ring ores" can be obtained at this mine. They consist of centers of pyrite coated with brown cassiterite and the interstices filled with the silver minerals. Here again is evidence to show that the silver mineralization continued later than the tin, though in part the two must be contemporaneous. In the vicinity of the Itos are several cross-veins, the oxidized zone of which is being worked on a small scale for tin. This material runs as high as 6% to 10% tin and is sorted into a shipping grade containing 60% tin and a milling ore with 5% to 6% tin. The ores from the Itos mine are taken over the hill by means of an aërial tram.

### Concentration of Tin Follows Leaching

Before the consolidation of the mines under the ownership of the two large Chilean companies the ores were treated in a number of small mills, but now each of these companies has a single large mill. Owing to the scarcity of water about Oruro, these mills are not located at the mines, but at other stations on the Antofagasta & Bolivia R.R. The mill of the Compañía Minera de Oruro is situated at Machacamarca, 24 km. south of Oruro, and that of the Compañía San José at the next station, Poopoo, 48 km. from Oruro.

The copper and silver are recovered from the sulphide ores by subjecting them to a chloridizing roast and leaching. The copper is recovered from the first washing after the chloridizing, and then the silver. The residue is subjected to concentration to recover its tin. At the Machacamarca mill the coarser than 100-mesh material is jigged in three-compartment Harz jigs with 1½-mm. screens and a bed 2½ mm. thick using but little water. The product of the three hutches furnishes a 71% concentrate. The jig product constitutes one-half of the concentrates. The other one-half comes from the tables that treat the less than 100-mesh size. The silver recovery averages about 84% and that of the tin about 93%. The process employed by the Compañía Minera de San José is essentially the same.

The oxidized ores are usually treated for the recovery of the tin only. Occasionally they are mixed with the sulphides and given a chloridizing roast in order to recover the silver, but the cost of fuel generally makes this inexpedient. The recovery of the silver content by the cyanidation of the tailings is under consideration.

The Compañía Minera de Oruro is treating daily 60 tons of sulphide ore and 20 tons of oxidized ore. The company struggled along for many years with indifferent success, but since the erection of the new mill about six years ago it has been highly successful, having not only wiped out a large accumulated deficit, but having paid dividends as well. This is largely due to the efficient management of H. F. Grondijs, who was for several years resident manager and who now, as consulting engineer, spends about four months on the property each year.

## Aramayo Francke Mines, Ltd., Moves Head Offices

Aramayo Francke Mines, Ltd., has recently moved its headquarters from London to Geneva, Switzerland, to escape the super-tax imposed on mining and other companies with headquarters in Great Britain. This company has extensive holdings in the south central part of Bolivia and produces tin, tungsten, bismuth, silver and copper. What has now developed into a great mining undertaking was initiated as a private concern in Bolivia in 1867. Upon the acquisition in 1906 of the interests of Carl Francke, a private limited company was incorporated under the English law under the style of Aramayo Francke & Co., Ltd. Following the acquisition of various properties in the Chorolque district and other neighboring sections, the title of the company was changed to its present name in January, 1911. All the original partners had meantime or previously established their residence in various cities in Europe, F. A. Aramayo, the chairman, having taken up his residence in London on account of early school associations in England. The company has paid handsome dividends in times of good metal prices.

As some of the principal shareholders reside in other places than England, it was felt that the super-tax resulting from the war was hardly justified in its application to these holdings. After considering various places in which to establish the new company, the directors finally settled upon Geneva, Switzerland, as offering all the advantages required. The cost of registration was only a few hundred pounds; there are a trade license and a municipal duty on profits amounting to 1½%, but when no trading is done in the district and all business is reduced to office work, these charges are greatly reduced or exempted.

There is no great advantage to shareholders resident in England from the proposed change, as they will receive their dividends with income-tax deducted as heretofore. Shareholders resident in foreign countries, however, will derive considerable benefit. For the sake of illustration it may be assumed that the profits of the company will be £100,000 net in any one year. In England £25,000 would have to be paid as income tax and for other contingencies at least the sum of £15,000, leaving for distribution £60,000. In Geneva, out of the same amount of profits the company would be able to distribute about £90,000 to shareholders. British shareholders will thus enjoy a slight advantage by reason of the greater amount to be available for distribution as dividends. This may in a measure be counterbalanced by the sentimental objection of moving the company to a foreign or neutral country during the time of war and the possibility of the products getting into enemies' hands. In this connection it is interesting to know who are the principal German shareholders in this important Bolivian enterprise. The chairman stated that the most important of all was the "Ernst und Matilde Francke Stiftung," a philanthropic institution created by one of the original partners, which holds 78,880 shares. The other principal shareholder, holding 20,740 shares, is V. M. M. Braun, for many years connected with the company in Bolivia and later one of the members of the board of directors, and especially in charge of the sale of the company's products. His father was a Bolivian born, and his grandfather, General Braun, of Montenegro, one of the leaders in the war for South American independence.

The directors of the new Swiss company are to be F. A. Aramayo, chairman; Carlos Aramayo; Nicholas Veja, a Chilean gentleman residing in Paris; Alberto de Aguilar, son-in-law of the chairman, residing in Madrid; and Gustave Ferriere, who has lately been at the head of the Huanchaca Co. in Paris and who will take charge of the new headquarters in Geneva.

## The Consolidated Interstate-Callahan Mining Co.

The Consolidated Interstate-Callahan Mining Co., operating near Wallace, Idaho, reports a profit of $3,100,491 for the year ended June 30, 1916. From this and a previous surplus, dividends of $3,254,930 ($7 per share) were paid and new property acquired valued at $181,817, leaving a profit balance at the end of the year of $806,711. As much ore was opened in orebodies already developed as was extracted, without recourse to sinking. Sufficient ore is developed above the No. 6 level to insure operations for three or four years. The report also states that work will shortly be completed to enable explorations to be made (on level No. 7) about 225 ft. below anything before explored.

During the year development work amounting to 6,493 ft. was performed: Sinking, 570 ft.; crosscuts, 3,229 ft.; drifts, 2,073 ft.; raises, 211 ft.; assessment tunnels, 380 ft. Stations and skip chutes amounting to 41,999 cu.ft. were cut. There was 123,684 wet tons of ore taken from the mine, from which 10,244 tons of ore was sorted from the belt and shipped direct. This ore had a tenor of 49.2% Zn. The balance of the output, 113,440 wet tons, ran 2.6 oz. Ag, 6.3% Pb, 27.8% Zn and 5.8% Fe. The mine worked 361 days and the mill 351 days. The mine output was 342.6 wet tons per day, and the mill and sorting plant had an output of 187.2 tons. The mill during the latter part of the year recovered 90% of the zinc value in the ore. Detailed results of milling operations are given in the accompanying table.

DATA OF THE INTERSTATE-CALLAHAN MILL

| | Mill Feed | Zinc Product | Lead Product |
|---|---|---|---|
| Tons | 120,198 | 61,211 | 4,504 |
| Lead contents, % | 8.85 | 5.84 | 49,87 |
| Lead contents, lb. | 11,642,219 | 7,149,901 | 4,492.318 |
| Zinc contents, % | 46.50 | 48 60 | 18.59 |
| Zinc contents, lb. | 61,174,840 | 59,500,386 | 1,674,454 |
| Silver, oz. per ton | 3.66 | 2.42 | 20.52 |
| Silver, oz. | 240,756 | 148,315 | 92,411 |

The gross value of lead and zinc crude ore and concentrates as sold to smelters was $4,631,205. The average cost of mining and milling was $5.457 per ton of ore mined.

## Japanese Mineral Production

The figures of production from Japanese mines for the first six months of 1916 show in general a considerable increase over the like period in 1915. Owing doubtless to heavy absorption in war munitions for Russia, the increases recorded for copper and iron are 20.1% and 38.9% respectively. The following tabulation comprises the figures of the Department of Agriculture and Commerce:

JAPANESE MINERAL PRODUCTION FOR SIX MONTHS

| Mineral | Production | % Increase* |
|---|---|---|
| Gold | 3,959 kg. | 7.5 |
| Silver | 80,385 kg. | 10.0 |
| Copper | 39,123 m. tons | 20.1 |
| Iron | 33,219 m. tons | 38.9 |
| Coal | 10,001,417 m. tons | 8.3 |
| Petroleum | 225,811,800 liters | 1.5 |
| Sulphur | 40,366 m. tons | 38.1 |

*Over corresponding period for 1915.

# The Inspiration Mine Plant*

*SYNOPSIS—The description of a mine plant designed to work a deposit containing 100,000,000 tons of ore at an average depth of 500 ft. A discussion of the requirements of each section is given, together with the reason for the choice of equipment finally adopted. The salient features of the mine plant are as follows: The dual arrangement of the entire plant; the automatic loading and hoisting of ore; the application of the elevator principle for handling men; and the reduction of the crude ore for mill treatment in two simple stages.*

The Inspiration Consolidated Copper Co.'s plant at Miami, Ariz., was designed and built to make possible the profitable working of a low-grade finely disseminated copper deposit containing 100,000,000 tons of ore averaging 1.64% in copper values.

From the beginning it was evident that the plant could not be kept integral, but that a break would have to be made somewhere in the flow sheet, removing at least the concentrator to a site more suitable than any that was available near the mine. It was finally decided, after considering numerous alternative arrangements, to do the coarse crushing at the mine, Fig. 1, to store the crushed ore in a bin from which it could be loaded into railroad cars and to haul it to the concentrator, an excellent site for which was available about 1¾ mi. from the mine.

The original intention was to equip a plant to treat 7,500 tons of ore per day, but through the acquisition and proving up of additional ore reserves, the introduction of the Ohio caving system and the excellent results obtained in the test mill (which made it possible to treat a lower-grade ore than had been thought possible), it was evident that a plant of much greater capacity could be supplied. It was therefore decided to treat approximately 15,000 tons of ore per day, the duties of the four main divisions to be as follows:

DUTIES OF MAIN DIVISIONS OF THE PLANT

| Division | Operating Time in Hr. | Capacity in Tons per Hr. | Daily Capacity in Tons | Available Capacity, Tons |
|---|---|---|---|---|
| Hoisting plant..... | 15 | 1,000 | 15,000 | ..... |
| Crushing plant..... | 15 | 1,000 | 15,000 | ..... |
| Storage bin..... | .. | .... | ..... | 25,000 |
| Concentrator ..... | 24 | 625 | 15,000 | ..... |

The sites for the plants as finally decided upon permitted of an arrangement entirely adequate to meet the proposed requirements, but the following important features may be noted:

The mine-plant site is contiguous to the orebodies, but at a safe distance from ground to be caved; it occupies a position as regards elevation well suited to a favorable hoisting arrangement and allows of a downgrade to the concentrator of 0.3%. The shortest line from the shafts to the orebodies approximately bisects them, making possible a very direct underground haulage system; the site occupies a remote corner of the property and does not lie in the general trend of the mineralized zone. The mill site has a slope favorable to the type of mill erected and is of sufficient area to allow of an economical arrangement of the various units of the plant. There is ample storage space for tailings and an excellent reservoir site available for the storage of water.

As the life of the property was estimated to be 17 years or longer, depending upon new developments in

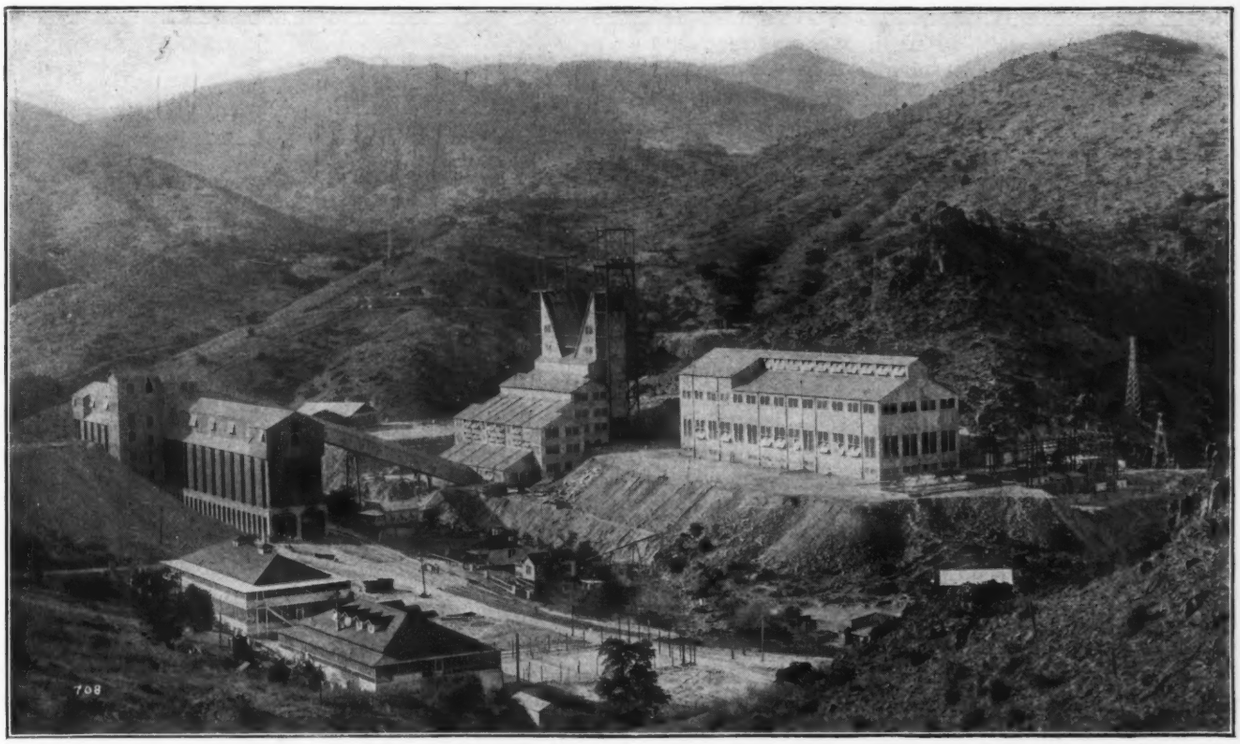

FIG. 1. INSPIRATION MINE PLANT, LOOKING WEST

*Excerpts from an article by H. Kenyon Burch, B. S., chief engineer, Inspiration Consolidated Copper Co., to be presented at the Arizona meeting of the A. I. M. E., September, 1916.

the treatment of lower-grade ores, it was decided to make the various structures of a semipermanent character. The buildings are of steel with corrugated steel coverings, except the concentrator, which has a four-ply composition roof. All windows as well as skylights are of rubber-glass. The floors throughout are of concrete, the retaining walls of reinforced concrete and machinery foundations of massive concrete with little or no reinforcing. Reinforced concrete was used wherever applicable.

Electric power is obtained from two sources. The Reclamation Service of the United States Government from its hydro-electric plant at the Roosevelt Dam, 40 mi. away, furnishes energy at 40,000 volts 25 cycles three-phase.

In conjunction with the International Smelting Co. the Inspiration company built a power house which utilizes the waste heat from the reverberatories under one set of boilers. There is also another set of boilers, oil-fired, which is used when the power demand is greater than can be supplied by the waste-heat boilers alone. This power house contains three 7,500-kv.-a. steam-turbine driven generators, delivering energy at 6,600 volts 25 cycles three-phase; and also three 15-lb.

The subject will be handled according to the following general scheme: First, the reasons will be given that led to the adoption of the type of plant finally decided upon; this in turn will be followed by a general description of the plant, and finally, each step will be dwelt upon as much in detail as is consistent with the novel features that any particular method or appliance may possess. Reference to Fig. 2 will aid in following the description.

The relation between the orebodies and the mine plant can be described as follows: Conceive of a chain of orebodies, which in their lateral extension take the form of a parabola, with its vertex pointing to the north and having a length of approximately 9,000 ft. Place the main haulageways on either side of the axis, 60 ft. apart, and open them to surface through two three-compartment shafts, 102 ft. centers and distant from the nearest approach of the orebodies about 750 ft. Group the mine plant symmetrically about the axis between the shafts and the orebodies, and a general idea of their relation is obtained (Fig. 2).

As a result of the preliminary studies, the dual arrangement of the mine plant was evolved, the primary

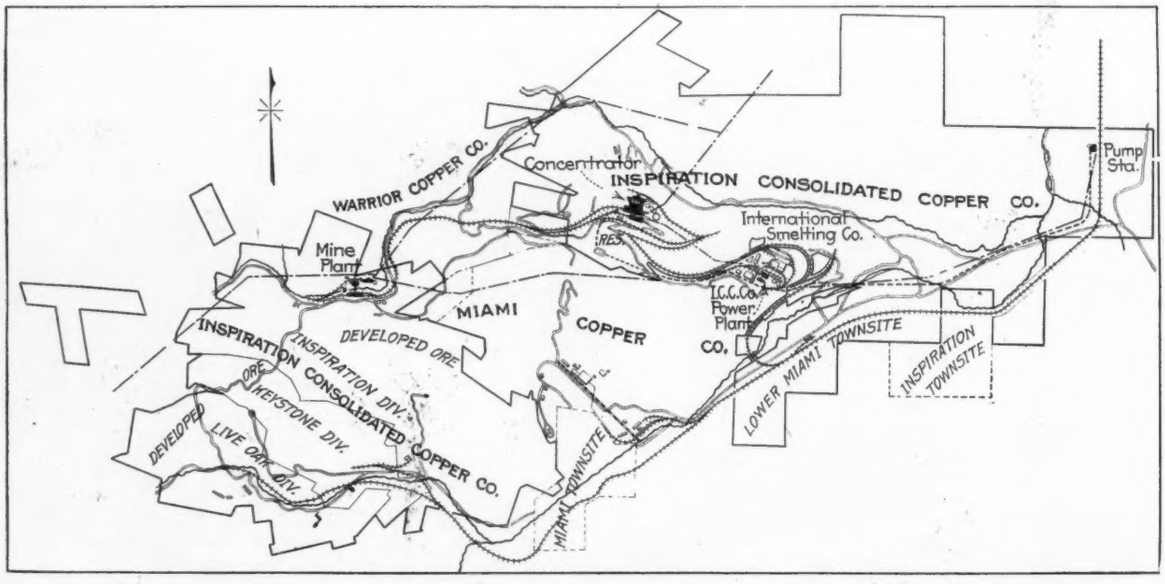


FIG. 2. MAP SHOWING RELATION OF THE SEVERAL UNITS OF THE PLANT

reciprocating blowing engines, each having a capacity of 15,000 cu.ft. of free air per minute. The air is for the smelter use exclusively, while the electric energy is for the mining, smelting and ore-dressing plants.

The distributing system is so laid out that any division of the plant can take power from either source. When available, the Reclamation power is used for the greater part of the Inspiration load. Each unit of the plant has its transformer station for stepping down the transmission-line voltage. Motors of 50 hp. or greater are run on 2,200 volts, smaller motors on 440 volts and lighting circuits on 110 volts. Synchronous motors are used as required, to maintain a satisfactory power factor.

Under the general heading of mine plant will be considered that portion of the plant with its adjuncts which takes the ore from the mine cars, hoists it to surface, reduces it to a size suitable for mill treatment and places it in storage, ready for transportation to the concentrator.

consideration being the necessity of handling 1,000 tons of ore per hour, which in itself precluded the use of a single shaft. Two shafts would also insure continuity of service. It was then considered advisable to follow this idea a step further and to make the whole mine plant duplicate in its arrangement, which would give reasonable assurance against total shutdowns and also permit of a better load factor.

Crude ore from the stope chutes is hauled in trains of 25 cars each by compressed-air locomotives to the loading stations at the main shafts (Fig. 3). All ore tapped from the chutes has been broken to pass a 12-in. grizzly, so that no further attention has to be given it after it is once in the cars. At the shafts the cars are dumped, five at a time by motor-operated tipples, one for each shaft on the 600 or main haulage level, with a third on the 400 level. All hoisting is done from the main haulage level. The tipples on the 600 level dump

directly into 1,600-ton pockets, beneath which are the automatic measuring and skip-loading devices. There are four of these, two for each shaft. Here the ore is automatically measured and loaded into 12-ton skips. On the surface it is dumped into a 2,000-ton crude-ore bin lying between the shafts and serving both (Fig. 4).

The crushing plant is composed of four similar units, one of which is here described: A 48-in. apron feeder takes the ore from the crude-ore bin and discharges it over a 3-in. bar grizzly, feeding a No. 8 gyratory crusher set to crush to 4-in. cubes. The discharge from the gyratory and the throughs from the grizzly are conveyed by a 30-in. inclined belt conveyor to two 48-in. disk crushers, the ore first passing over a 1½-in. bar grizzly. This conveyor has a magnetic head pulley for removing tramp steel. The 48-in. disk crushers are set with a maximum opening of 2 in., their discharge and the throughs from the 1½-in. grizzlies joining on two 36-in. horizontal cross-belts, which in turn discharge at the center of the building on the two main inclined belts, also, of 36-in. width. These belts are 300 ft. long, travel at 350 ft. per min. and are equipped with hand-adjusted

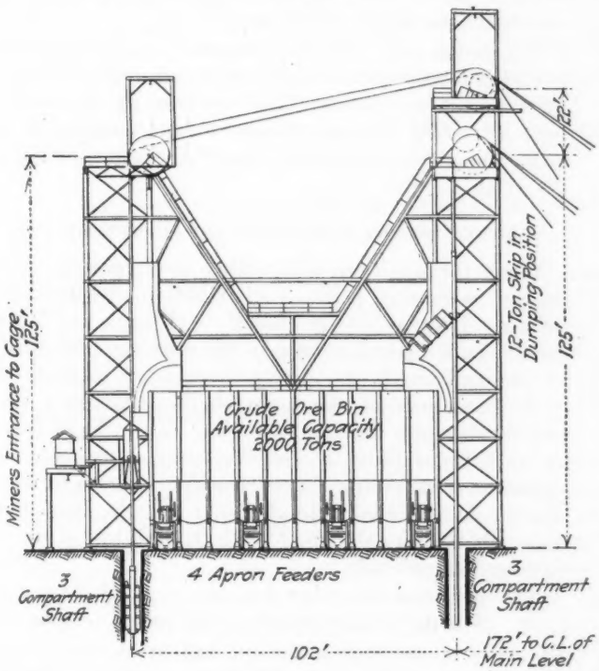


FIG. 3. SECTION THROUGH HEADFRAMES, SHAFTS AND BINS

tail-pulley takeups and also with weighted tension carriages. They discharge on four 24-in. horizontal conveyors over the storage bin, each of which has an automatic tripper which distributes the ore uniformly throughout the bin. Weightometers are placed on the two main inclined belts, thus giving a record of the ore handled. Fig. 5 is a cross-section of the plant.

At the point where the main inclined belts discharge on the horizontal cross-belts is placed the heads sampler. This consists of a rectangular cast-iron bucket, 9x30 in. on the end of a revolving arm 10 ft. in length. The bucket runs on a circular track 12 ft. 4 in. in diameter and is driven through a wormwheel mounted on a vertical shaft making a revolution every forty seconds. The bucket has a swinging cutoff type of gate for a bottom. In its travel it cuts the two main ore streams taking out $^1/_{120}$ and at a point 180° from the ore stream strikes a tripper which causes the gate to open and the sample to be discharged into a 10-ton hopper. From the hopper the sample is fed by a roll feeder and started on its way through the sampling plant, which is placed against the center of the storage bin opposite the main conveyors. Here the sample is first passed through a 24-in. disk crusher, a $^1/_{15}$ cut is then made with a Snyder sampler and this cut is delivered to a set of 27x14-in. rolls. The roll product is cut by a second Snyder sampler, this $^1/_{15}$ cut going to a mixing drum which equalizes the flow. The resulting stream is delivered to a duplex Vezin sampler making two $\frac{1}{10}$ cuts. These samples are duplicates and weigh 110 lb. each and represent a day's run. The rejects from the three samplers go to an elevator which discharges into the storage bin. Fig. 2 shows the exterior of the sampling plant. Having the general scheme of the mine plant well in mind, a more detailed review can now be made.

### Underground Haulage by Compressed Air

Underground haulage is confined to two levels, the 600 or main haulage level, and the 400 level. The main haulage level is, in turn, made up of two distinct systems each serving its main shaft. All haulage is to be controlled by a block-signal system. Two types of motive power for underground haulage were considered—electric and compressed air. On account of less danger to life due to the elimination of bare conductors, the compressed-air locomotives was chosen rather than the electric. The difference in the efficiency of the two systems is probably a very small percentage of the total cost.

The locomotives are of the two-stage, four-wheeled type and have a weight on the drivers of 10 tons. The initial cylinder air-pressure is 250 lb. and the charging pressure 800 lb. per sq.in. The haulage capacity per charge was estimated at 50 ton-miles. The locomotives haul 25 cars, each of five tons capacity on a 30-in. gage track over a 0.4% grade in favor of the load, and will negotiate a curve of 38-ft. radius.

Three tipples are in use, two in accordance with the dual arrangement of the main haulage level station and the third on the 400 level. Each tipple is designed to dump five cars, each car weighing 14,000 lb. loaded. They have an overall length of 56 ft. and make a complete revolution in 15 seconds. The driving shaft is connected through suitable gearing to a 35-hp. motor which runs continuously in one direction, the starting and stopping of the tipple being accomplished by means of a friction clutch on the intermediate shaft. Each tipple is provided with an automatic stop which brings it into the proper position for running on and off the cars, this stop being released by means of a foot lever on the operator's platform. The two main tipples are operated from a centrally located platform.

The two main underground pockets serve as storage for the automatic measuring and loading devices which are placed beneath them. The capacity of each pocket is 1,600 tons, or 800 tons for each loader, which, with full pockets, will run the crushing plant about 3 hr. They are of reinforced-concrete construction throughout and are lined with 2-in. planks. The upper pocket has a capacity of 500 tons and is connected to the lower pockets by an inclined chute.

Taken individually, the shafts do not deviate materially from usual designs, being of reinforced concrete throughout. They are of the same size, each being made up of three compartments 5 ft. 6 in. by 5 ft. 11 in., the two south compartments of either shaft being for the ore skips. The north compartment in the West Main serves the man elevator and the corresponding compartment in the East Main is taken up by pipe lines, ladderways and the elevator counterweight. All platforms, supports and ladders in this compartment are of steel. The conduits carrying the power and lighting circuits underground are in the end walls, being brought to junction boxes every 100 ft.

The ore skips are built according to special designs. They have a nominal capacity of 12 tons and weigh 17,000 lb. each. The overall length is 21 ft., the skip proper being 14 ft. deep. The body is of ⅜-in. steel plate with liners to take up concentrated wear.

In order to keep the sumps at the bottom of the shafts clean and to facilitate the handling of ore which does

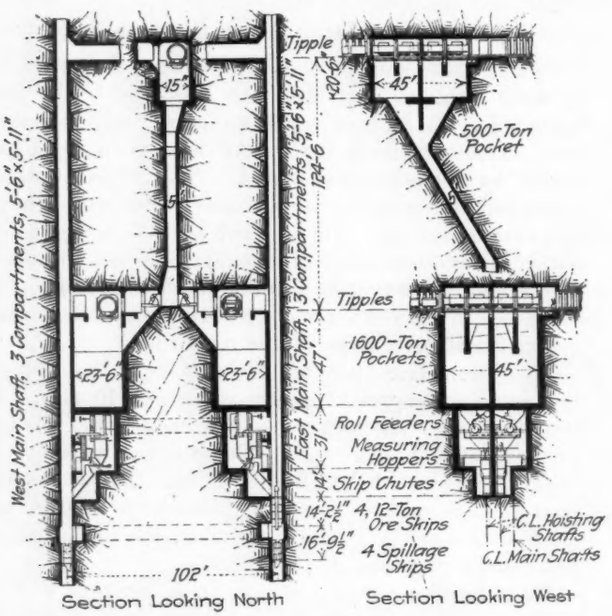


FIG. 4. UNDERGROUND POCKET ARRANGEMENTS

find its way below the skips, spillage skips have been installed. These rest on chairs 17 ft. below the ore-skip chairs and by means of hinged aprons completely close off the shaft. When one is filled, it is attached to the bottom of the ore skip and hoisted to the top of the underground pocket, where by opening a hopper bottom it is discharged. They have a capacity of nine tons each.

At the time it was decided to sink two shafts, the conditions seemed to favor the use of two entirely independent hoists, located symmetrically on either side of the main headframes. It was next proposed to put the two hoists under the same roof, but to operate them independently of each other. Then on account of the advent of several new conditions it was deemed advisable to see what could be done toward making the operation of the hoists automatic. The conditions were as follows: (1) The contract with the United States Reclamation Service for the supply of power called for flywheel equalization of peak loads which in turn made necessary the use of a motor-generator set. This condition was in perfect accordance with the equipment as finally decided upon as being best suited for automatic hoisting. (2) All supplies and waste rock were to be handled through a tunnel opening, thus leaving the main hoists with no other duty than that of hoisting ore. (3) Extending over considerable periods of time all ore was to be hoisted from one level, thus permitting of always running the two skips in balance. (4) Men were to be handled by a separate hoist. (5) The moderate depth of shafts permitted the use of low-speed hoists.

Both shafts are vertical, with a present depth of 585 ft., although an ultimate depth of 1,000 ft. will be used and had to be provided for in the hoist designs. The nominal capacity of the two hoists when running automatically is 1,000 tons per hour. The ore skips operate in balance, each weighing 8½ tons and carrying 12 tons of ore.

The hoist drums are of the cylindrical type, 10 ft. in diameter by 65 in. face and have a capacity of 1,000 ft. of 1¾-in. rope. One drum of each hoist is provided with a clutch which is air-operated. The brakes are of the post type, air-operated with oil cataracts and compensating levers. Each hoist is driven through gearing by a direct-current motor of 585 hp.

The hoists are entirely automatic in their operation, but either can be manually operated independently of the other if so desired. The problem as presented has been solved in a most efficient manner, sufficient proof being the entire satisfaction that the equipment has thus far given.

### Elevator for Lowering and Hoisting Men

When the question of handling men came up, several courses as regards point of distribution presented themselves. They could be handled through an existing tunnel, hoisting or lowering to the working levels through an inclined shaft, or entirely through an inclined shaft, or through one of the main shafts, whichever scheme proved the most feasible, the idea was to have the men do as little walking as possible, ample provision to be made for transferring them from changehouse to working places. It was finally decided that distribution from the main shafts was the most logical, and the shafts were equipped accordingly.

The next consideration was the type of hoists to be used. Standard mine practice favored a separate hoist manually operated and working against a counterweight. This type made necessary the services of two attendants, one on the cage and one at the hoist, but in working out probable operating costs the idea was conceived of eliminating the hoist attendant by an application of the elevator principle. Studies along this line were at once begun, but no great amount of enthusiasm among the manufacturers could be aroused on account of the unusual conditions. Equipment was wanted to handle a counterweighted, double-deck cage, weighing 7,100 lb. and loads of 7,500 lb., the maximum speed of the cage to be 800 ft. per min. The fact that the hoist and counterweight would have to be removed from the elevator shaft also presented a new feature in the design. It may be stated, however, that placing the hoist in the headframes directly above the shaft, as is the usual practice in office-building design, was at one time considered.

The equipment as installed is operated entirely from the cage, the hoist, motor-generator set and control

apparatus being in the hoisthouse about 220 ft. away. The motor driving the d.c. generator on the motor-generator set has a rating of 190 hp., the generator developing 130 kw. The hoist is driven by a d.c. motor of 158 hp. It is provided with a safety brake so arranged that when the hoist is stopped the brake is automatically applied to hold the cage. This brake is actuated by spring pressure, is constantly in service except when electrically released during normal operation of the hoist and is therefore instantly applied in case the current supply is interrupted from any cause. Additional safety devices are provided which take care of overwind, overload on motor, slack cable, etc. Two oil-cushioned buffers are provided at the bottom of the shaft, being so designed as to bring the loaded cage to a gradual stop in case from any cause, while running at normal speed, it should not stop at the lower terminal. The cage is equipped with a telephone that keeps the attendant in touch with the hoisthouse, also with an annunciator system covering the several levels (Fig. 4).

Each level and the collar is provided with a two-story station, which makes it possible to load both decks without shifting. The cage accommodates 36 to 40 men besides the attendant. The surface station, which is in the headframe, is connected with the changehouse by a covered runway. From the underground stations the men are transferred to the various working places in cars accommodating 12 men each and drawn by the haulage locomotives.

### Automatic Measuring and Loading Devices Used for Skips

To carry out the automatic feature of the hoisting equipment, it was desirable to make the loading of the skips automatic. There being nothing on the market that could be used for this purpose, it was necessary to work up complete designs in accordance with original ideas. In a few words the device can be described as follows: Ore from one of the 1,600-ton underground pockets rests on a roll feeder actuated by a pawl-and-ratchet wheel and is fed into a 12-ton measuring hopper. This hopper is suspended between the legs of a U-shaped scale beam with fulcrums at the ends. Through a link at the middle of the yoke the proportional weight of the hopper and ore is transferred to the main scale beam, which carries a counterweight of 1,370 lb. Motion obtained from the counterweight scale beam when the hopper becomes filled is utilized to operate a system of levers and lift the pawl from the ratchet wheel, thus stopping the roll feeders. The hopper is now ready to be emptied.

As the returning empty skip settles on the chairs, it strikes an arm projecting into the shaft. This arm is connected by a system of links to the shaft on which the yoke of the gate forming the bottom of the hopper is hinged. The motion imparted to the system by the skip trips the gate yoke, the weight of the ore in the hopper causes the gate to drop into the skip chute, and the hopper is emptied into the skip. As soon as it is empty, a counterweight on the gate causes it to close, all motions are reversed, and the measuring hopper is again filled.

A cutoff gate is provided which prevents the roll feeder from becoming bare in case the pocket should be emptied.

A 5-ft. layer of ore thus protects the feeder and does away with excessive impacts due to the dumping of the ore from the tipple 50 ft. above. A 5-hp. motor furnishes the required power for the roll feeders of each pair of loaders.

### A Four-Unit Coarse-Crushing Plant

The loaded skips assume a dumping position at a point about midway between the shaft collars and the center of the sheaves, leaving about 25 ft. for possible overwinding. The sheaves are 125 ft. above the shaft collars. They are 12 ft. in diameter and pressed on 8½-in. shafts. 8-ft. sheaves on 6-in. shafts being used for the man-elevator ropes. The dumping tracks are of usual design. By means of chutes leading away from one compartment of each shaft, an even distribution of the ore is effected throughout the length of the crude-ore bin. This bin is of rather unusual design and very nearly self-cleaning. The bottom slopes down 45° either way from a hip center toward the vertical back and front, a section resembling a capital M inverted. Gates are placed under the bin on the slope toward the back as well as on the front of the bin. This arrangement of bottom and gates not only allows the bin to be emptied, but the ore is prevented from packing or hanging up

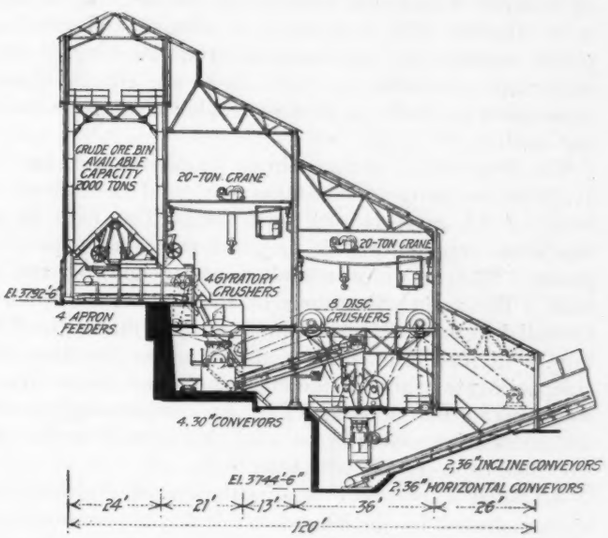


FIG. 5. SECTION THROUGH CRUSHING PLANT

by drawing off alternately from the rear and front gates. The gates are 48 in. wide and are operated by rack and pinion from runways. For each unit of the crushing plant two gates, one under the bin and one in front, discharge on an apron feeder which travels across and under the bin (Fig. 5.).

The feeders are of the apron type, have a width of 48 in., a length of 25 ft. 6 in. between centers and travel at 7 ft. per min.; 20-in. belt conveyors traveling at 7 ft. per min. and driven from the feeder sprockets are placed beneath the feeders to take care of drippings. These discharge into chutes that join the undersize from the grizzlies. Wood scraps are removed from the ore at the discharge end of the apron feeders and also from the inclined conveyors leading to the disk crushers. These scraps are carried away by two 20-in. belt conveyors traveling at 75 ft. per min., running across the building and dumping outside.

The four units of the crushing plant are driven by four 200-hp. motors in two dustproof rooms, symmetrically

arranged on either side of the plant. Except for some minor reductions, belt transmission is used throughout.

Two 20-ton electric cranes are installed in the plant—one to serve the gyratories, the other the disk crushers, motors, etc. These are in turn connected to the yard track by transfer cars and a 20-ton electric trolley hoist, running at right angles outside of the building. Each 200-hp. motor is served by a 6-ton crawl so arranged as to allow of crane handling after leaving the motor room. A repair car and track near the gyratories permits of easy handling of their driving mechanisms, or bottom plates.

### Storage Bin of 25,000 Tons Capacity

The purpose of the storage bin in connection with a mine plant is identical with that of a flywheel on an engine—to give out and absorb energy when variation in the load occurs suddenly. It does away with the necessity of maintaining a nice balance between mine and mill and allows either, for a short time, to cease running altogether or to run at a lessened capacity. Where the mill is removed from the mine plant, it also furnishes an economical means of transferring the ore into railroad cars. Besides this, it allows of a hoisting and crushing period considerably less than full time running, a very important consideration, since there are always repairs to be made in shafts, to loaders, tipples, hoists and crushing machinery.

The Inspiration storage bin is double-tracked, has an available capacity of 25,000 tons and will load a train of 14 cars without switching. The base is of reinforced concrete and is provided with four expansion joints. The bin proper and conveyor housing are of steel. The main dimensions of the bin are as follows: Overall length, 465 ft.; width, 40 ft.; depth, 40 ft. The bin is divided into three compartments, the two end compartments being for the storage of special ores if any such are ever encountered. They are comparatively small, accommodating one car on each track and having an available capacity of 1,700 tons each.

As noted before, an even distribution of the incoming ore is effected by the use of automatic trippers on four 24-in. conveyor belts. These belts are driven by two 50-hp. motors placed at either end of the bin. The ore is drawn off through hand-operated gates of the swinging cutoff type, there being three openings for each car.

### Compressor Equipment for 1,000- and 100-Lb. Air

Compressed air is used for two distinct purposes—for underground haulage and for mine drills. For the first 1,000-lb. air is used and 100-lb. for the second. The haulage system is served by two compressors, each having a capacity of 1,125 cu.ft. of free air per min. at 107 r.p.m. These are of the duplex four-stage motor-driven type, the cylinders being cross-compounded, water-jacketed and having intercoolers between each stage. These compressors have an automatic regulating scheme whereby, when a predetermined high-pressure point has been reached, the 1,000-lb. discharge line is cut out and the four cylinders are converted into a double-compound compressor discharging directly into the 100-lb. main. Each compressor is driven by a 430-hp. self-starting synchronous motor.

The low-pressure equipment consists of two 100-lb. compressors having capacities of 3,000 and 7,270 cu.ft. of free air per min. Both compressors are of the parallel two-stage type, all cylinders being water-jacketed with intercoolers between the two stages. The 7,270-ft. machine is equipped throughout with Hoerbiger-Roegler plate valves, which, on account of the very short movement and exceedingly light construction, permit of a very high compression efficiency. The cylinders of this machine are 46 in. and 28-in. by 36-in. stroke. It is driven by a self-starting synchronous motor of 1,150 hp. The 3,000-ft. machine is driven by a 500-hp. self-starting synchronous motor at 107 r.p.m.

Two 100-kw. 125-volt motor-generator exciter sets arranged to operate in parallel serve as exciters to the compressor motors. Cooling water for the jackets and intercoolers is obtained from a circulating system consisting of a duplicate installation of 750-gal. triplex pumps and a spray cooling pond.

The compressors and hoisting equipment are housed in a spacious and well-lighted building which has a 25-ton electric crane running its entire length and connecting at one end with a well into which railroad cars can be run and unloaded. A 22-panel remote-control switchboard, together with the low-tension (2,200-volt) bus equipment, occupies a room along one side of the building, the high-tension transformer station being outside near one end of the building. Only two attendants per shift are required, one being an oiler. Without the automatic features for hoisting ore and the elevator for handling men, at least four would be required.

## The Taxation of Montana Mineral Lands

By A. L. H. Street*

The Anaconda Copper Mining Co. conveyed certain lands to purchasers, reserving underlying minerals, the right to remove them and a right-of-way across the surface for the purpose. Subsequently the tax assesor listed the entire property to the purchasers at its full cash value and at the same time assessed the mineral reservations to the company at $5 the acre. The tax authorities refused to cancel the latter assessment, and the company, having paid the tax against it under protest, sued the county to secure a refund.

In affirming a judgment in favor of the county, the Montana Supreme Court holds that, under the constitution and laws of the state, the mineral interest in the land was taxable apart from the interests sold to the purchasers of the real estate proper and that, although there was an invalid double assessment of the property in that the minerals were assessed both to the company and to the purchasers of the land, the company showed no right to complain. The court intimates that if there was any just cause for complaint, it was in favor of the owner of the land. (158 Pacific Reporter, 682.)

**A Silver-Palladium Alloy** is recommended for use in contact-and-spark devices to replace platinum, according to "Journal Society of Chemical Industry," Apr. 29, 1916. An alloy of silver with 2% Pd gives satisfactory results under many circumstances. When the contacts or spark points are exposed to sulphur compounds, 5% Pd or more should be used. The alloy which gives the greatest resistance to spark erosion is that of 60% Pd and 40% Ag. Additions of palladium to silver raise the melting point and lower the thermal conductivity.

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# Importance of the Human Factor

By Fred H. Rindge, Jr.*

*SYNOPSIS—Success in all business today, whether in mining or industrial lines, depends in a constantly increasing degree upon the workers' character, efficiency and friendliness. The employer's responsibility for the welfare of his employees is greater than ever. Worldwide conditions of change demand increased efficiency of the employee. Personal sympathy between employer and employee is necessary to effect this increase.*

Let any skeptic of the increasing importance of the human factor in the success of any business ponder this well: It is almost impossible to read any high-class publication today without finding the subject of the human factor thrust well to the fore. Let the skeptic investigate a pile of his own mail accumulated during an absence, with an eye to investigating the truth of this statement, and he will probably be suppressed by an experience similar to my own.

Returning to my office after two months' absence and finding the usual accumulation of mail, a rapid sorting and sampling yielded the following results: Several engineering magazines contained articles dealing with management and its relation to the human factor. Three issues of one business man's magazine contained such articles as "Handling Men," "Changing Over Wage-Payment Systems," "How to Organize for Safety." A succession of booklets described the profit-sharing scheme of a large manufacturing company, the welfare activities of another, etc. Bulletins of the American Iron and Steel Institute contained such articles as "The Scope of Welfare Work," "How to Reach the Man and Reduce Accidents," "The Cooling of Heated Working Places," "Restaurants Versus the Dinner Pail for Industrial Workers."

### Judge Gary Advocates Generosity to Employees

My thought at this point was that such things cost money and times are uncertain. But turning to a recent address of Judge Elbert H. Gary, chairman of the board of directors of the United States Steel Corporation, I read: "In times like these I ask you to consider not only the propriety but, more than that, the pleasure of being fair, reasonable and generous in our treatment of our employees." I recalled that during the past year the Steel Corporation spent more than $7,000,000 in improving the conditions surrounding its men. Surely Judge Gary and many other leaders in industry believe that consideration of the human factor is right and that it pays.

Several bulletins of the American Museum of Safety contained the usual number of articles on accident prevention and safety devices, and papers on "A Successful Experiment in Educating Illiterate Workers" and "Alcoholism in the Industries." This was indeed getting close to the human factor. In the last article I read: "It has now been proven beyond a doubt that the use of alcoholic drinks impairs the health and the efficiency of the laborer, slows the fingers of the textile operator, dulls the mind of the financial accountant and impairs the discernment and judgment of the railroad engineer." This was not a temperance sermon, but a matter-of-fact efficiency discussion. Surely any agency that might help men to "cut out the booze," that might educate men and improve character, would help to increase efficiency. Even a motion-picture booklet contained the phrase, "The bitter battle waging between the motion picture and the grog-shop."

### College Course in Industrial Management

Several college catalogs showed that some of the engineering courses are giving considerable attention to the problems of management and the human factor in industry. An announcement of a University of Wisconsin extension course in industrial management reads: "Business policy reflects the ideas of the individual behind the business, and the adoption of the right policy is a most important factor in the success of the enterprise. Similarly, the solution of the problem of the relations of individuals within a business is of first importance in bringing about efficient management and efficient operation." In the record of a Western college I read: "The world needs today, more than it can know, leaders equal to the growing opportunities for improving human life in manifold forms of social service. The world needs today in commerce, in manufacturing, in banking, in mining, in distribution, in transportation, men with a conception of the meaning of their enterprises and their opportunities far beyond the scope of technical preparation." I found also the engineering journal of a large university containing a series of articles on "The Human Side of Engineering" and another college periodical with a discussion entitled "Socializing the Engineer." Surely these are steps in the right direction, for they lead to the day of future engineers, who must be as never before men who consider always the human factor.

A reprint of a scientific paper described the industrial service movement of the Young Men's Christian Association, read by Prof. J. W. Roe, of Yale, at a meeting of the American Society of Mechanical Engineers. Also another article by J. Parke Channing read before the American Institute of Mining Engineers. It is significant that these national engineering societies are also taking a leading part in the promotion of the human side of the engineering profession.

Of course, if one wanted to mention other books and publications of the day dealing directly or indirectly with the human factor, there would be no limit. But I am merely drawing illustrations from a part of the material found on my desk after a two-months' absence. The whole country is becoming increasingly interested in, and is giving more consideration to the human factor in industry. And this is my theme. If anyone doubts its importance, let him look through any newspaper, glance at the titles on any good bookshelf, witness the awakening of our schools and colleges, talk with industrial and social leaders, read the platforms of political parties, observe the progress of big business, note the propaganda of labor organizations, stumble over work of socialists and anarchists, be impressed by the ten million industrial workers in America, and live in the world of real people with

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reawakened senses—for on the human factor all success depends and within the human factor are the potentials for great evil or for great good.

In one sense the human factor is profoundly influenced—yes, practically controlled—by the whole "social switchboard," and each of us is one of the operators. Arthur D. Dean, of the University of the State of New York, has admirably developed this idea:

> **The progressive sees the educative process as a huge, complicated switchboard—distributing, it may be, the heat of physical needs; or the power of a national material supremacy; or the light of the higher impulses of a people. He sees the main feed wire leading to it, carrying the burdens of humanity—a bulky, low-voltage current of mysterious life forces. He sees switches, connections, lead wires of agencies social, industrial, educational, emanating from the switchboard. He sees wires leading into the pathways of men, carrying currents of human desires and needs into every darkened pathway of human relationships. And over it all he sees the community—the civic conscience of a people manipulating these switches, readjusting connections, plugging in a new agency in order that the income current of a common humanity may be rehabilitated, redistributed, redirected, into a world of service adapted in amperage and voltage of personal power and accomplishment to do the task assigned—a task of service-rendering with knowledge, power and joy.**
>
> **Yes, the switchboard distributing these human agencies is complicated. It is a network of wires confusing in such a civilization as ours. In the hands of the standpatter, the switchboard is a blurred mass and all its paraphernalia appears to him so useless, so unlike the days of candles, so utterly confusing in its ignorance and narrowmindedness, he turns away in disgust.**
>
> **To the radical the switchboard is equally complicated, but instead of studying out its connections and making necessary readjustment, he would, with a big movement of his hand, maybe with bombs and dynamite, tear off the switches, short-circuit the connections, and pull out the plugs. He glories in the smash, dances fanatically before the flashes of light and goes down into the darkness of the chaos.**
>
> **The progressive stands on an insulated mat; follows the blueprinted diagram in the pulling out of the plugs, connecting the wires, and labeling the connections—all for a purpose. You ask, "What is this purpose?" It is the increase of human wealth and happiness.**

We might sum up this whole question historically in terms of modern industry somewhat as follows:

### Increased Responsibility of Employer

With successive changes in the basis of labor, the relations between employer and employee have become more complex. The transition from early slavery, through serfdom to the modern wage basis, has increased the distance between employer and employee, while elevating the plane of their relationship. While employers may no longer have to clothe and feed their workers, they still have a direct responsibility for their welfare. The slave was supported and could be compelled; the serf was protected and could be controlled; but the wage-earner of today is presumed to be independent and may therefore be neither compelled nor controlled. He must rather be coöperated with and encouraged. The employer is now upon the plane of mutuality with his employees instead of being the owner, autocrat or "housefather" that he once was. Employers have not been freed from responsibility by the changing order; while their direct authority over the worker has decreased and they have been further removed from actual contact, their responsibility has actually increased.

Ambassador Bryce has said that in no country is public opinion so powerful as in America. Today public opinion is placing emphasis upon the responsibility of employers. Their obligations are being emphasized not only by critics, moralists and reformers, but by the widespread sentiment of the people, expressed in sympathy with the demands for a living wage, reasonable hours, good working conditions, one day's rest in seven, employer's liability for injuries, sick and death benefits, pensions, profit sharing, welfare club, etc.

It has been said that the successful employer is probably neither hero, saint nor philanthropist, and that he will probably fail in business if he attempts to become any of these. This is largely true; but on the other hand, if public opinion prevails and the new standards now above the horizon are established, the employer will have to embody something of all these qualities. Employers generally will have to do what some have already learned to do so splendidly; namely, to serve the interests of the business, the worker and the community. This is a high but not unreasonable ideal for the employer.

Turning to the other side of the question, what conditions have the changes in the basis of labor brought about for the employee? Certainly each change has meant improvement. Better conditions by far obtain today in the leading industrial countries than ever before. In North America particularly we have shorter hours of labor, higher wages, improved health and increased safety for the worker. There has been developed also a far more independent, self-reliant spirit than in other countries. The working man in America, being better paid and working amid better conditions, has better standing socially and politically than in other countries, and it is not overstating the case to say that at least the skilled worker is more intelligent and efficient.

### Increased Efficiency Duty of Employees

We may not assume, however, that because this is true now it will always remain so. Some of the conditions that have favored the American workingmen are changing. The abundance of raw material and the New World energy has made it comparatively easy for America to forge to the front by shear force of output. But material is becoming relatively scarce, and keener competition must be waged hereafter with certain other nations. Tariffs are no longer a dependable protection for wages.

As each of these factors in former industrial advantage disappears, there comes the demand for some compensating factor, and we can find it only in increased skill and efficiency on the part of the worker. This is a most serious matter for both employer and employee. Efficiency and skilled workers are already scarce—every employer knows this—and there is not enough supply in sight. The increase in skill has not kept pace with industry's progress. Is our American system of education at fault, and are the boys being educated away from the industries? Has society looked down upon the industrial worker while smiling upon the clerk and the professional man? Or has industry imposed too heavy demands upon the workers? I do not try to answer. But a remedy for this condition must be found. It is evident that the needed skill and efficiency cannot come without education. More attention must be given to vocational training of workers, and it is encouraging to note that educators, employers, philanthropic agencies, and more recently trades unions, are recognizing this. If organized labor would do as much toward increasing efficiency as it has toward increasing wages, what a contribution it would make!

But the change that has done most to prevent the larger prosperity and progress of industrial workers is the

increasing distance between the employer and employee. The growth in size of manufacturing plants has separated those who are bound together in interest, and the contacts that formerly made friendliness possible are diminishing. This personal intercourse and sympathy between employer and employee is the medium for the transmission of that subtle something which, while having no place on the records of industry, has been the basis of industry's greatest achievements. Call it morale, loyalty, esprit de corps or good will, it is that which is described by one under the "art of war." "In all periods of war," he says, "under all conditions of arms, the moral forces which affect armies have been the great determining factors of victory, and upon the nice feeling of the moral pulse of armies the skill of great commanders has chiefly depended." The present war illustrates this better than any other war in all history.

What I have in mind is illustrated by an employer whose testimony is entitled to respect because as president of a large mill he has been successful in paying dividends and in winning the good will of his employees. He says: "The financial interests of my corporation require that I shall do everything possible to improve the workers' character, efficiency and friendliness." Notice the emphasis on the economic value of these three things—character, efficiency, friendliness. The conditions surrounding and affecting employees are not only the employer's concern, but his responsibility as well—this responsibility to be expressed not in paternalism but by fraternity, which is the real need of industrial workers. How shall the general public as well as the business man view all these things? What is our individual responsibility? Are we sufficiently cognizant of the importance of the human factor in industry today?

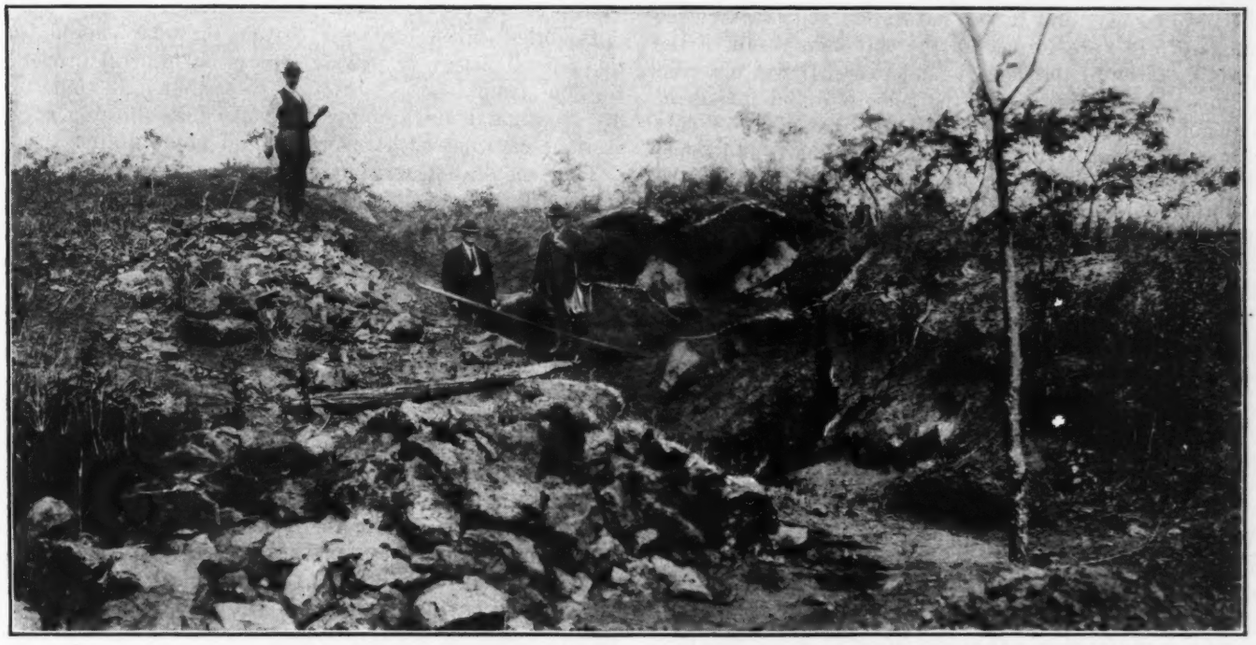
**In the Recent Zeppelins** the angle-brackets are stated by "Le Genie Civil" to be: Al, 90.27%; Zn, 7.8%; Cu, 0.73%, with small amounts of Fe, Si, Mn and Sn. For the channel sections the main constituents of the alloy were 88.68% Al and 9.1 Zn. The braces were commercial aluminum.

## Manganese in Tennessee

By Joel H. Watkins*

A shortage in imports of manganese ore at a time when the steel mills were never more active has caused a strong advance in the price of both manganese alloys and ores This increase in price and unprecedented demand for ore has so stimulated the mining of manganese in this country that many of the old abandoned mines and prospects have been reopened and exploited and some new deposits have been brought to light. One of the most interesting of these recent discoveries of manganese is in Bradley County, Tennessee, about eight miles south of Cleveland and about one mile east of Weatherly, a siding on the Southern Ry.

The underlying rocks of this area, as shown on the Cleveland Tennessee folio, United States Geological Survey, are mostly Silurian and Cambrian sediments. Those horizons which are exposed in the immediate vicinity of the manganese deposits are the Tellico sandstone, Holston marble, Chickamauga limestone, Knox dolomite and Caunasauga shale. The rocks of this area are much folded and faulted, the folds having a general northeast-southwest trend and the major faults being parallel with the axes of the folds.



REMOVING THE MANGANESE FROM BETWEEN PINNACLES OF MARBLE

The rocks to which the manganese deposits owe their origin are the Tellico sandstone and the Holston marble, which in this area dip to the southeast at an angle of about 25° with the horizontal. Normally, beds of Athens shale lay between the Tellico sandstone and Holston marble, but at this point the shale seems to have disappeared and the standstone rests directly upon the marble. Near the contact between the two formations thin ribbons of sandstone are interbedded with the marble. The Tellico sandstone when perfectly fresh is a hard, compact, coarse-grained gray rock, the grains of sand being cemented with calcareous and ferruginous cement. On weathering,

*Economic geologist, Washington, D. C.

the cementing material is largely leached out, leaving a porous, light, friable mass and often reconcentrating the iron oxide into a soft, purple, low-grade residual iron ore. A deposit of iron ore formed in this way has been worked to some extent at a point about two miles north of Sweetwater, Tenn., which is in the same general district. The analyses of ten samples of soft ore taken from this mine showed an average iron content of 38.77%. and an average manganese content of 5.51%.

### Manganese in Clay and Sandstone

The manganese ore occurs for the most part as disseminated fragments in a mantle of highly ferruginous sandy residual clay which rests directly upon Holston marble. With the Tellico sandstone carrying about 2% and the residual about 5% manganese, conditions would seem particularly favorable for the deposition of botryoidal or "kidney ore," which is the usual mode of occurrence of manganese oxide in residual clays. On my first examination of the deposits, soon after development work had begun, considerable ore was being taken out of openpits in the residual clay and it was natural to suppose that the lumps of ore were formed in the clay as a result of the breaking down of the Tellico sandstone. It was observed at this time, however, that the smooth round masses of manganese were entirely absent and that the ore only occurred in angular massive blocks with sharp and sometimes ragged edges. On a later visit, when the prospects had been more extensively worked, it could be plainly seen that the manganese was not deposited in the residual, but that it represented the replacement of Holston marble along crevices near its contact with the Tellico sandstone, the seams of manganese being later weathered out of the marble. This was perfectly shown in one case where a seam of manganese about 6 in. thick extended entirely through a pinnacle of marble and the broken remains of the portion of the seam that had been weathered from the marble rested in the residual around the pinnacle. This same condition was also observed at several other places, leaving absolutely no doubt as to the origin of the ore. Along the contact of the manganese with the inclosing marble for about an inch or more there was a complete gradation from the manganese into the marble.

The ore is of excellent quality, very low in phosphorus and silica and high in manganese content. Unfortunately, however, it proved to be too high in iron for use in the manufacture of dry batteries. Two average analyses of the ore are as follows:

AVERAGE ANALYSES OF MANGANESE ORES

| | No. 1 | No. 2 |
|---|---|---|
| Phosphorus | 0.142 | 0.100 |
| Silica | 0.70 | 0.50 |
| Iron | 3.33 | 2.24 |
| Manganese | 54.20 | 56.10 |

Up to the present only about 200 tons of the ore has been shipped, which has all been taken from within a few feet of the surface. The pits and opencuts have been located without regard to system or economy. Men were set to work anywhere that a small amount of float could be found, and at first one man would some days dig out from one to two tons of ore. Some of the blocks of ore weighed from 400 to 600 lb. and had to be broken up before they could be lifted from the pits. Some of the pits showed but little ore and some were entirely barren. In one field about 10 tons of ore was simply plowed up from within a foot of the surface. As the mine was being developed by several local men who were not experienced in mining, this splendid surface showing of course caused considerable excitement. They have later, however, gotten down to a working basis and are now stripping the top of a low hill along the zone in which the manganese is disseminated.

The Tellico sandstone is exposed almost continuously in a northeast-southwest direction through the valley of east Tennessee for a distance of about 75 mi. Similar occurrences have recently been observed both north and south of Cleveland, but it is now reasonably certain that the ore will not be found in very large deposits. It is probable, however, that at other points in Tennessee where the Tellico sandstone is exposed and where all the physical conditions are favorable, similar deposits may be found from which several hundred tons of high-grade ore can be handily mined.

## The Nature of Private Reports

By A. H. Purdue*

Doubtless much has been written on what should be the general nature of private reports on mineral properties, but from a large portion of those that have come to my attention I am prompted to make the following suggestions on what such reports should *not* contain:

They should not, except in possible rare instances, deal at all with the age of the rocks in which the minerals occur that are being reported upon. This for two reasons: First, because clients hardly ever know or care anything about the age of rocks. To them it makes no difference whether the rocks are of Ordovician, Devonian, Cretaceous or some other age. What they want to know is whether they contain mineral, and if so, whether it occurs in such quantity and under such conditions as to permit of its recovery at a profit. The second reason is because such reports are often made by engineers who are not geologists, or by geologists who are not familiar with the stratigraphy of the area being reported upon. In either case what is said of the age of the rocks must be second-hand. Many times I have seen private reports that attempted the detailed descriptions of the geological sections involved, these having been taken from the writings of some highly capable geologist who had worked out the stratigraphy only after long effort over wide areas. The regrettable fact is that such descriptions usually are given without any credit at all. However, as they are nearly always bungled, it is perhaps as well, from this point of view, that credit is not attempted.

The recommendation to omit all reference to the age of rocks does not mean that attention should not be given such phases of the geology as deal with lithologic character, structure, topography and such other features as relate directly to the occurrence of the deposit described and to its recovery.

Another thing that should be omitted is all discussion relating to the origin of the deposits. Such is of interest to geologists and engineers and forms most desirable material for professional papers, but if embodied in private reports, it makes them tiresomely long and rarely has any meaning to the man who is interested in a mineral deposit for the money he can make out of it. A commercial report showed some commercial ends.

*State geologist of Tennessee.

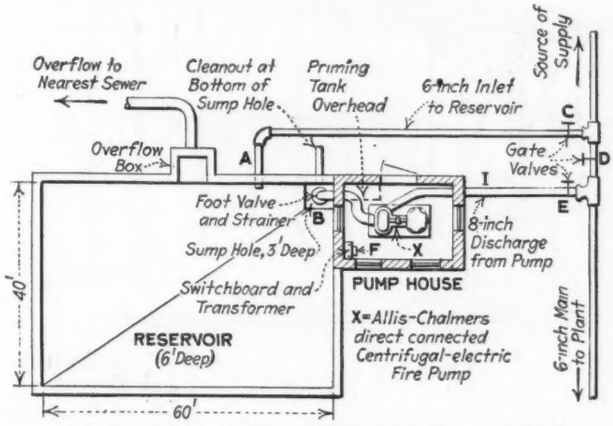
# Details of Practical Mining

## A Reservoir and Pumphouse

By G. F. Alderson*

The reservoir and pumping equipment herein described was installed recently to be used as a means of raising the pressure in a system to 80 lb. for fire-protection purposes, under normal conditions the supply being available at 20 lb. A 100,000-gal. concrete reservoir was first constructed. This was filled from the ordinary water supply of the plant, and it was used as an emergency supply for an electric pump, which in case of fire pumped against the pressure head in the plant main and increased this ordinary pressure up to that of a high-pressure system during the time that the requirements demanded.

By referring to the accompanying diagram the scheme of the new system may be seen at a glance. The reservoir is filled from the source of supply through the inlet pipe *A*. The floor of the reservoir drains toward a sump *B*,




PIPING ARRANGEMENT FOR RESERVOIR AND PUMPHOUSE

in which is placed the foot valve and strainer on the suction end of the pump. Normally, the valves at *C* and *E* are closed and the valve at *D* is open. Thus the reservoir is shut off from its supply except in case of fire, when the valve at *D* is closed and valves *C* and *E* are opened. These valves are controlled by a single hand-wheel within the pumphouse. Should a fire alarm be turned in, the pump is started by throwing the switch at the board *F*. The valves *C* and E are open, and the valve at *D* is closed. In starting the motor, the pump is primed automatically by means of a priming tank placed above it in the pump house. Immediately the pump begins to draw the water from the reservoir and pump it to the discharge *I* into the main leading to the piant, which action at once increases the pressure in the main up to that necessary for producing the desired result through the firehouse.

When starting the operation, the valve at *C* is opened and the water at ordinary pressure flows into the reservoir, thus virtually increasing its capacity, for perhaps 30,000 gal. has flowed into the reservoir while the pump is drawing out 100,000 gal., and so the water is drawn out much faster than it enters. The quantity that flows in is enough to increase materially the length of time that the pump may draw from the reservoir.

The dimensions of the reservoir are 40x60 ft. with an average depth of 6½ ft. It was constructed of concrete reinforced with ½-in. square twisted steel rods. The floor of the reservoir is 6 in. thick, and the side walls are 12 in. thick. Both the walls and the floor were poured in one continuous operation, thus securing a proper bond. In the shallow portion of the reservoir the water is 6 ft. deep, and in the deepest part at the edge of the sump there is a depth of 7 ft. The sump is 3 ft. square and 3 ft. deep. It gives ample room for the foot valve and strainer on the suction pipe and also provides space in the bottom for the collection of sediment. From the bottom of this sump a 4-in. pipe drains into the sewer system, and at regular intervals the valve is opened and the sediment washed out. At one side of the reservoir an overflow box is provided from which an 8-in. terra-cotta pipe connects with the nearest sewer.

To prevent dust and scum from accumulating on the water and to make freezing in winter more difficult, an ordinary sloping roof was built over the reservoir. This roof is supported by nine timbers, 8x8 in., resting on the floor of the reservoir. For a roof covering, a good quality of 2-ply prepared roofing paper was used.

The concrete used was a 1:2:4 mixture of portland cement, clean sharp bar sand and clear pit gravel. The concrete was hand-mixed, four boards working continuously until the floors and walls were finished.

The total cost of the reservoir was $2,819.63, with cost distributon as follows:

COST OF BUILDING THE RESERVOIR

| | | |
|---|---|---|
| **Labor ..... $1,672.23 (60%)** | | |
| Excavation, 804 cu.yd. (labor at $0.24 per hr.) | | $868.32 |
| Forms for concrete (carpenters at $0.53 per hr.) | | 230.55 |
| Laying outside piping (plumber at $0.45 per hr., helper at $0.35 per hr.) | | 71.82 |
| Pouring concrete, 136 cu.yd. (labor at $0.24 per hr.) | | 422.04 |
| Roof (carpenters at $0.53 per hr.) | | 79.50 |
| **Material ..... $1,129.40 (40%)** | | |
| Lumber (average $20 per M) | | 248.64 |
| Nails (average $0.0175 per lb.) | | 4.64 |
| Concrete, 1:2:4 mixture | | 500.22 |
| Cement, 181.25 bbl. at $1.30 per bbl. | | |
| Sand, 56 yd. at $1 per ton. | | |
| Gravel, 112 yd. at $1.30 per ton. | | |
| Reinforcing rods, 9,000 ft. (108 ft. per 100 lb. at $4 per 100 lb.) | | 333.00 |
| Wire, No. 12 (200 lb. at $0.112 per lb.) | | 22.50 |
| Roofing paper (34 squares at $0.60) | | 20.40 |
| **Total cost of reservoir** | Labor | $1,672.23 |
| | Material | 1,129.40 |
| | | $2,801.63 |

A fireproof pumphouse, 12x18 ft., was constructed at one end of the reservoir. This building housed an Allis-Chalmers high-duty, 1,000-gal. electric fire pump, together with all necessary fittings and appliances for its proper operation. The motor was connected to a 2,200-volt service line. The pump running at 1,750 r.p.m. operated under a head of 260 ft. To provide a means of priming the pump, a wooden tank was built and lined with copper. This tank was supported above the pump

*Civil engineer, Kennett Square, Penn.

by brackets placed on the wall. An automatic ball float valve keeps the tank properly filled.

The pumphouse is of fireproof construction, with cement floor, brick walls and concrete-slab roof supported by an 8-in. I-beam and reinforced with Hy-Rib. The I-beam is protected from fire with a covering of cement.

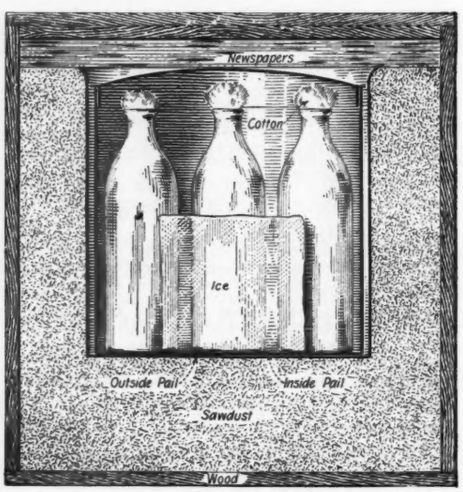
The cost of the pumphouse complete, but not including the pump or motor, was $784.03, itemized as follows:

COST OF ERECTING THE PUMPHOUSE

| | | |
|---|---|---|
| **Labor** ..... $536.07 (68%) | | |
| Masonry (masons at $0.70 per hr., helpers at $0.24 per hr.) | | $176.04 |
| Forms for roof (carpenters at $0.53 per hr.) | | 40.78 |
| Carpenter work, setting window and door frames | | 31.80 |
| Installing pump (plumber at $0.45 per hr., helper at $0.35 per hr.) | | 129.75 |
| Installing motor (electrician at $0.45 per hr., helper at $0.35 per hr.) | | 130.00 |
| Lining tank (coppersmith at $0.45 per hr.) | | 8.50 |
| Painting (painter at $0.375 per hr.) | | 11.25 |
| Labor at $0.24 per hr. | | 7.95 |
| **Material** ..... $247.96 (32%) | | |
| Brick (9,000 at $8.50 per M) | | 76.50 |
| Concrete work, foundation, roof, floor and mortar | | 49.60 |
| 22 bbl. cement at $1.30 per bbl. | | |
| 7 cu.yd. sand at $1 per ton. | | |
| 14 cu.yd. gravel at $1.30 per ton. | | |
| Four window frames at $1.75 each | | 7.00 |
| Paneled door and door frame | | 3.50 |
| 8-in. I-beam, 11 ft. 6 in. long | | 4.00 |
| Lumber, forms for roof at $20 per M | | 20.00 |
| Hy-Rib (270 sq.ft. at $0.022) | | 6.00 |
| Paint (3 gal. at $1.75) | | 5.25 |
| Pipe and fittings for connecting pump | | 71.61 |
| Material for priming tank | | 4.50 |
| **Total cost of pumphouse** { Labor | | $536.07 |
| { Material | | 247.96 |
| | | $784.03 |
| **Total cost of system** { Reservoir | | $2,801.63 |
| { Pumphouse | | 784.03 |
| | | $3,585.66 |

## Home-Made Ice Box

The following suggestion for a home-made ice box is given in "Miners Circular 20," issued by the Bureau of Mines, entitled "How a Miner Can Avoid Some Dangerous Diseases." It can be made at a small cost and will keep milk cool with a few pounds of ice a day.




A SIMPLY MADE ICE BOX

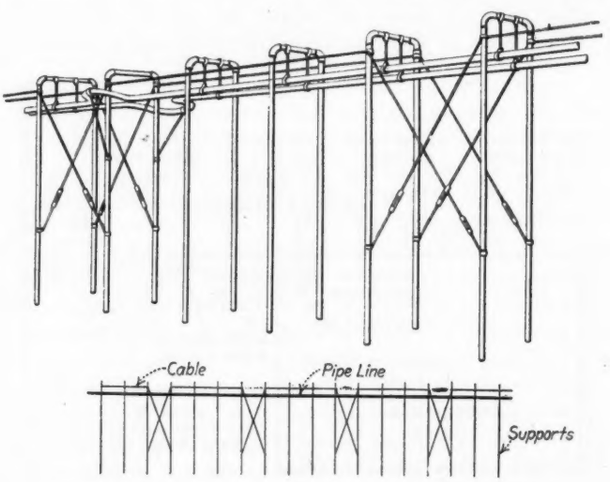
Get two tin pails, one of which will just fit within the other. The inside pail should have a cover and be large enough to hold the bottles and several pounds of ice. The outside pail should be placed in a box about 18 in. square and surrounded by sawdust, as shown in the figure. Be sure that a layer of sawdust separates the bottom of the outside pail from the bottom of the box. About 50 layers of newspapers should be tacked to the bottom of the wooden cover of the box.

## Effective Pipe-Line Support

The support of pipe lines in and about mine plants is a problem common to every superintendent. Where the lines are long, it often involves considerable expense, and where the topography is irregular or where a stream has to be crossed by the lines, it often resolves itself into an important matter.

Where timber is scarce or only obtainable in short lengths and where it is necessary to support the pipe line at a considerable height, say 30 to 40 ft. from the ground, the following method has proven cheap and effective. Where the material is at hand and haste is desired in erection, this method will also be found very rapid.

The materials necessary are: First, ordinary pipe, the diameter depending on the height of the line from the ground and the weight of pipe supported. In this particular instance a double 8-in. pipe line was supported at a height of 35 ft. with 3-in. pipe supports, placed 15 ft. apart. Two elbows of the same size are used to connect these supports. Second, sufficient steel cable to run two lengths parallel to the entire pipe line and allowing for the cables to come down ⅔ of the height of the vertical




METHOD OF SUPPORTING HIGH PIPE LINES

supports and cross between every fourth one, as shown in the sketch. Third, flat iron, hanger iron, bolts and turnbuckles for attaching cable, keeping it taut and supporting the pipe from the frame. The cable runs through eyes in steel or wrought-iron collars attached to the vertical supports. The pipe line is supported by ordinary pipe hangers.

A wooden sill embedded a few feet in the ground is usually sufficient to keep the supports from settling. In wet or marshy ground, however, it is safer to let the sill rest on a bed of broken stone or slag. Expansion bends may be put in the pipe and supported as shown. The cables should be kept taut by means of the turnbuckles and tested at regular intervals.

**Timber Chutes** in stopes where timbering is used and subsequently withdrawn are often advantageous. The chutes are usually placed next to the usual ore chute. This is often merely a skidway of three logs fastened together and projecting through the bulkhead and the side of the stope, through which it is more convenient to remove timber than through the ore chute. In some mines these skidways are several levels in height and are useful in the downward transferrence of timber. The stope is sufficient to produce motion but not to permit falling.

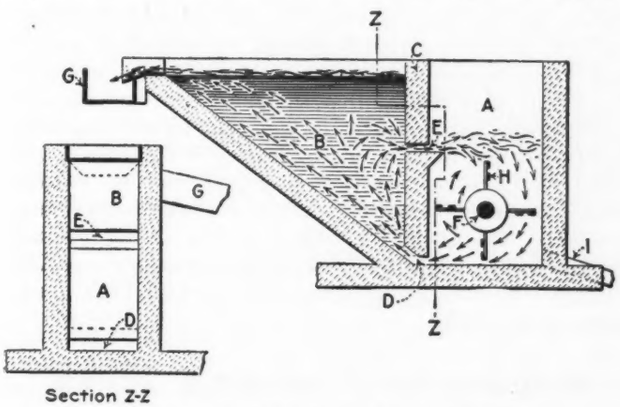
# Details of Milling and Smelting

## Eberenz and Brown Concentrator

By employing vertical, instead of horizontal, rotation of agitation blades it is proposed to accomplish with this machine in one cell as efficient work as now performed in a series of cells. The object is to economize floor space by increasing the agitation of a single cell.

A sectional view of the agitation cell and spitzkasten is shown in the accompanying diagram. The agitation cell *A* is separated from the spitzkasten *B* by the partition *C* in which are cut the transverse slots *D* and *E*. Within the agitation cell revolve vertically the impellers mounted upon the horizontal shaft *F*.

It will be seen on the diagram that the agitator is placed slightly below the transverse slot *E* and its blades in their travel extend down to a point approximately opposite to the slot *D*. The rapid revolution of the impellers mixes the air, oil and ore pulp, driving the




EBERENZ AND BROWN FLOTATION CELL

intermingled mass of material from cell *A* into the spitzkasten *B* through the transverse slot *D*. The metallic particles buoyed to the surface by the froth discharge into the launder. The tailings or gangue particles in the spitzkasten return to the agitation cell via the transverse slot *E* and thus are subjected to further agitation in contact with the frothing agent and air. During agitation the water in the spitzkasten rises to the level of the overflow, while within the agitation cell the level remains barely above the vanes *H* of the impellers, thus providing all the air necessary to create the froth. It is of course understood that the transverse slots *D* and *E* are so proportioned as to maintain the liquid level in the agitation cell lower than that in the spitzkasten. Tailings sinking to the bottom of the agitation cell are discharged through the spigot *I*. By thus repeatedly returning to this one cell middlings which ordinarily would be treated in a series of cells, this machine effects an economy of space and power.

The machine is the invention of George B. Eberenz and James I. Brown, of Cripple Creek, Colo., to whom U. S. Patent 1,187,822 was issued June 20, 1916.

## Purchase and Inspection of Leather Belting

The numerous forms of belting on the market may be divided roughly into three groups—first-quality oak-tanned leather, second-grade oak-tanned leather and novelties, according to an article in *American Machinist*, July 13, 1916.

First-quality oak-tanned leather belting shows the lowest cost per belt per year, provided it is properly installed and well cared for. For 30% more than the price of the cheaper grades the best that the market affords may be obtained.

Large users would do well to divide their orders between two sources of supply as a protection against the failure of one to make deliveries and to get the benefit of healthful rivalry.

Having chosen one or two sources of supply and found them satisfactory, every endeavor should be made to avoid frequent changes. Once a manufacturer has become accustomed to the particular needs of his customer, it is greatly to the advantage of both parties to retain the connection. Coöperation is essential to best results.

When belting is being bought or contracted for, it is always well to keep in mind that it may not prove satisfactory. This suggests at once that the kind of material desired should be specified definitely in writing and provision made for its rejection, if defective. Small consumers should order by brand from a reliable house, trusting to its fairness to make good any shortcomings in its product. Large buyers have an opportunity to specify more definitely what they require to meet their special needs and to safeguard themselves against the acceptance of poor material.

Specifications having been determined upon, bids should be invited from five or six of the leading manufacturers for the ensuing six months or a year. The leather market is always a very uncertain factor, especially at this time, and most manufacturers do not look with favor on long-time contracts. Six months is probably a fair period to all concerned.

There are decided advantages in keeping a good stock on hand. Rush orders are thereby obviated, ample time for inspection is available, and most important of all, the manufacturer is able to accumulate from stock in progress the kind best suited to the needs of the customer. The value of such selection cannot be over-estimated.

It is a long road from the cattle range to the pulleys of the mine plant or mill, and many operations are necessary to transform a steer hide into a leather belt. At almost every one of these stages the value of the product to the consumer can be influenced for better or for worse. The skill and knowledge of the workman, the condition of his equipment and the kind of supervision under which he works—all combine at each operation to determine whether the belt shall finally be a powerful aid to successful factory operation or the source of endless trouble. Unfortunately, the conditions under which his

product is sold and consumed do not give the belt manufacturer much incentive to keep all his processes at high efficiency. Most of his product goes to jobbers and supply houses, from which it is passed on in small quantities to the consumer, generally with price as the incentive rather than quality. Under these conditions a good appearance is often considered more important than invisible quality. This situation leads to practices akin to the coloring of butter, bleaching of flour and polishing of rice, largely practiced by manufacturers of foodstuffs. Only by constant and vigilant inspection can such practices be eliminated and defective material or workmanship discovered. The mere fact that delinquencies are promptly detected and reported to the manufacturer is sufficient to minimize their occurrence.

Where purchases are being made from more than one source, detailed inspection will soon point out their relative merits and the causes. It has the further advantage, also, that defects discovered before installation save the time and money involved in repairs, replacement and loss of production. A large user can well afford to assign a high-grade man to this duty, preferably one who is in close touch with operating conditions throughout the plant.

Two inspection tables with rotating tops should be provided and set a convenient distance apart in a good light. When a shipment is received, each roll should be placed on one table and wound onto the other. The entire length of the roll is thus exposed for inspection, and the rewound roll is left ready for storage or use. While the belt is passing before the inspector, he can readily check up the length, width, uniformity of thickness, shimming, excessive evening and other external characteristics. The most important points to watch are injurious blemishes, piping, cracking and the length of section. The overall length of the individual sections of which the belt is composed should not exceed 54 in., nor should many of them be less than 42 in. Longer lengths have been cut into the shoulder area, the least desirable part of the hide for belting, while shorter sections, even if of good material, introduce too many cemented joints, each of which is a potential trouble maker in service.

Another point to be watched is uniformity of character, especially as to pliability. Color, however, has no significance if the material is otherwise satisfactory. The manufacturer's name, brand and date should be plainly stamped every 10 ft. as a means of identification in case the service rendered should later prove unsatisfactory.

It is well, also, to unroll a length of about 50 ft. on the floor, noticing whether the belting remains flat at all points without pressure and shows straight laps. A little curvature will be observed, but it should not exceed a foot or two, should be all in the same direction and fairly uniform throughout the entire length. Such belting will run true on the pulleys under a slight tension.

All but the largest consumers can safely conclude their examination at this point, with the assurance that they are getting a very good belt. The process sounds elaborate; but as a matter of fact, when the proper facilities are provided and the inspector has become accustomed to his duties, a speed of 1,000 ft. per hr. can easily be attained. All the foregoing tests need not be applied to each roll, but the most important should be applied to every foot of belting purchased. In this way the consumer makes sure that the belt is going to give satisfactory service.

Occasional tests should be made to determine the percentage of greases introduced during manufacture to promote pliability and to protect the belt from absorption of foreign matter such as lubricating oil, water, fumes, etc. This examination should follow the standard practice of the American Association of Leather Chemists.

The presence of mineral oils, inorganic acids or anything detrimental to the strength, pliability or durability of the leather should be detected by suitable tests. Likewise, loading for artificial weight by means of white lead or other foreign matter can be detected by burning a sample and weighing the ash.

## Radium from Carnotite

Extraction of radium from Colorado carnotite ores is described by H. Schlundt in the *Journal of Physical Chemistry,* Vol. 20, p. 485. The experiments were made on 10-kg. portions ground to 20-mesh and gradually introduced into 18 liters of 78% sulphuric acid at 190° C. contained in a 50-liter cast-iron vessel and then heated to 220° C. for at least 15 min. The calcium, barium and radium are held in solution as bisulphates. The liquid is then cooled to 130° C., and the insoluble silicates are filtered off on "Filtros" under a pressure of 5 to 10 cm. of mercury. The washing is done with two portions (5 liters each) of hot concentrated sulphuric acid. The acid filtrate is then poured into eight times its bulk of hot water, precipitating the radium and barium. If dilute barium-chloride solution be added, the resulting precipitate will carry down 2% more of Ra. After standing at least three days the solution is siphoned off and the sulphates washed on a stone filter with hot water containing a little barium chloride. If the residue of the filter is agitated several times with hot water and filtered, a deep-blue solution is obtained from which a white precipitate gradually deposits, containing 3 to 9% of the original radium content of the ore. With low-grade ore the radium concentration is about 235:1; with high grade ores, about 35:1.

## Magnet for Charging Scrap

In steel plants there is a certain amount of scrap iron and steel produced from the rolling mills. This is usually collected into a waste pile and mixed with the charges of raw ore and then retreated. This scrap iron is loaded into charging boxes at the scrap heap and from them into the furnace. The scrap for the most part consists of structural-steel shapes, rails, rods, etc., and owing to the diversity of shape is not conveniently handled by mechanical means.

To overcome this an electromagnet was designed to remove, with a certain amount of selection, these steel parts and load them into the charging boxes. The magnet is of the compound type—composed of several magnets of the usual spool type mounted on a yoke in the form of a circle, the centers being on the circumference of an inner circle. A single magnet having its center coincident with the center of the outer circle completes the larger magnet and presents the maximum surface density. This large magnet is suspended from an overhead traveler and is provided with the usual horizontal and vertical motions. Each magnet is individually controlled so that material may be handled to a nicety by the application of current to the proper magnets.

# The Assayer and Chemist

## Qualitative Separation of Tin, Arsenic and Antimony

The method of Noyes and Bray for the qualitative separation of arsenic, antimony and tin consists in treating a mixture of the higher sulphides with concentrated hydrochloric acid in the steam bath, thus leaving the sulphide of arsenic undissolved, then diluting the liquid with about four volumes of water and precipitating sulphide of antimony in hot solution with hydrogen sulphide, and finally precipitating sulphide of tin after further dilution.

According to J. M. Welch and H. C. P. Weber (*Journ. Amer. Chem. Soc.,* Vol. 38, p. 1011) this does not give satisfactory results in the hands of inexperienced operators on account of failure to adhere to the exact conditions. They observed that when antimonious and stannic sulphides happen to precipitate together, they frequently show a brown color which is not intermediate between the usual colors of the two sulphides, but much darker. The authors consider this dark precipitate as a characteristic test for both tin and antimony, and they prefer to allow the hydrochloric-acid solution to cool while hydrogen sulphide is being led in, so as to obtain this test if possible. To finish the analysis they dissolve the sulphides by evaporating or using an oxidizing agent, then add oxalic acid (F. W. Clarke's method), precipitate antimony with hydrogen sulphide, boil the filtrate with granulated lead and test for tin with mercuric chloride.

## The Assaying of Copper Bullion

By G. W. Partridge*

In the autumn of 1913, owing to revolutionary disturbances, a large part of the copper ores coming to the Aguascalientes smeltery was cut off, and at the same time the receipts of gold and silver ores from southern Mexico were greatly increased. In consequence the blister copper produced began to carry abnormal amounts of precious metals. The method of assay in use at the time was the "combination" nitric acid for silver and "all scorification" for gold. This proved unsatisfactory under changed conditions, so I did some experimenting with the sulphuric-acid method in use at Anaconda, finally adopting it altogether in preference to the other.

Four charges of 15 grams each are weighed into 800-c.c. beakers; about 30 c.c. of water is added to each, and then 10 c.c. of mercuric nitrate solution (40 grams of mercuric nitrate per liter). This is shaken till the copper is coated with mercuric amalgam, then 60 c.c. of con. sulphuric is added, the beaker covered and put on the hot-plate. Action begins at once with evolution of $SO_2$ gas. Heating is continued for about 1½ hr. till the solution becomes bluish-gray. I find the best results are obtained by starting the action at a rather high heat.

When the action is finished, as shown by the bluish-gray color, the beakers are removed from the hot-plate and allowed to cool. When cold, the sides are washed down and sufficient salt solution added to precipitate the silver as chloride (the greater part of the silver is reduced to metallic state by the copper, but salt solution is always added). The solution is then brought to a boil and, when possible, allowed to stand over night. It is then filtered, washed a couple of times and the paper and contents transferred to a 20-gram crucible. The paper is burned at a low heat, flux added and the contents fused. The resulting buttons are cupelled, weighed and parted as usual.

The comparative results on fifteen lots are given in the table.

ASSAYS GIVEN IN KILOGRAMS PER METRIC TON

| Lot No. | Au by Scorification | Au by $H_2SO_4$ Combination | Ag by $HNO_3$ Combination | Ag by $H_2SO_4$ Combination |
|---|---|---|---|---|
| 1 | 0.2820 | 0.2817 | 33.307 | 33.342 |
| 2 | 0.3821 | 0.3814 | 45.740 | 45.734 |
| 3 | 0.3733 | 0.3739 | 49.053 | 49.072 |
| 4 | 0.2806 | 0.2861 | 37.335 | 37.332 |
| 5 | 0.2920 | 0.2927 | 34.846 | 34.972 |
| 6 | 0.2762 | 0.2778 | 29.992 | 30.083 |
| 7 | 0.2383 | 0.2381 | 24.995 | 25.017 |
| 8 | 0.2283 | 0.2287 | 23.930 | 23.913 |
| 9 | 0.2211 | 0.2221 | 22.618 | 22.689 |
| 10 | 0.1935 | 0.1928 | 20.780 | 20.680 |
| 11 | 0.1363 | 0.1386 | 19.272 | 19.334 |
| 12 | 0.1368 | 0.1363 | 19.412 | 19.384 |
| 13 | 0.1432 | 0.1446 | 18.925 | 18.901 |
| 14 | 0.1964 | 0.1956 | 31.818 | 31.869 |
| 15 | 0.3450 | 0.3465 | 40.988 | 40.984 |
| Average..... | 0.2483 | 0.2491 | 30.200 | 30.221 |

As the sulphuric-acid method gave good results, the other was discontinued and no further comparisons were made. It may be of interest that the values in the bullion increased to a high mark of 88 kg. of silver and 1,200 kg. of gold.

The combination nitric-acid and scorification method cost 84c., while the sulphuric-acid method cost 29c. per assay for materials only.

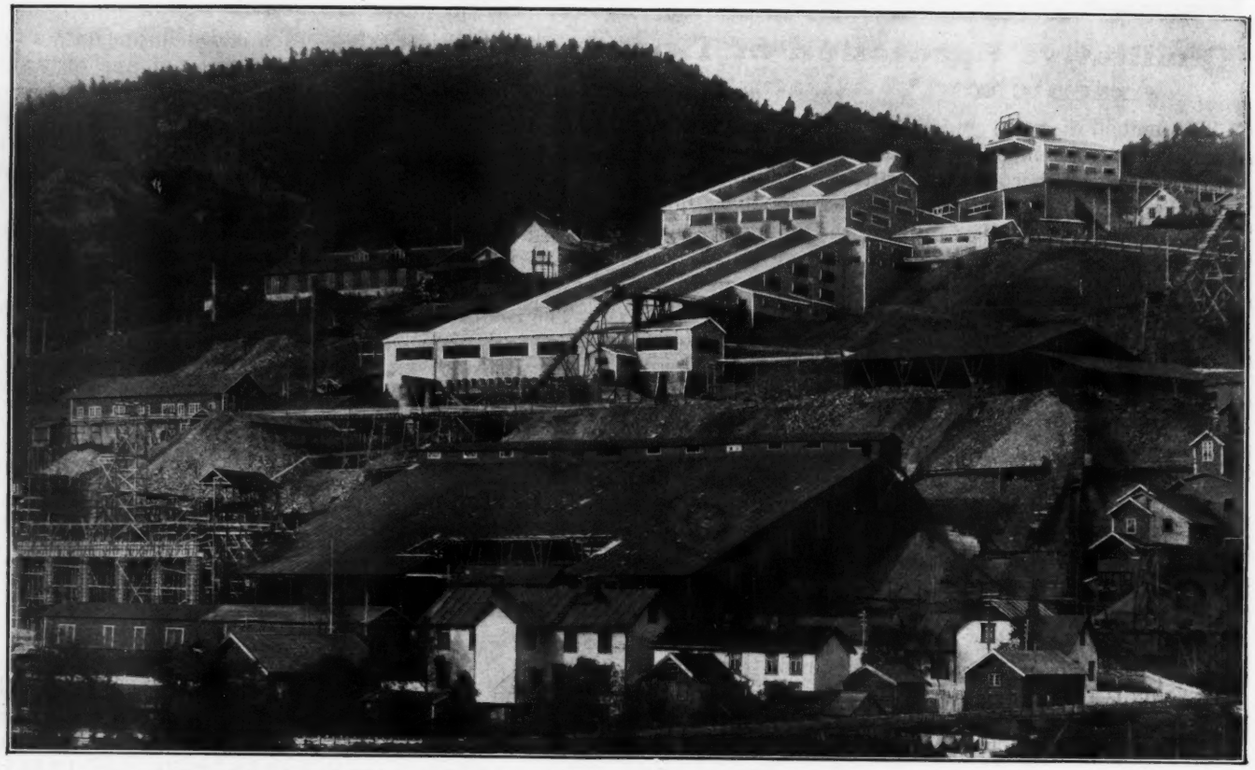
## Separation of Aluminum

A new gravimetric separation for aluminum from zinc, manganese, nickel, cobalt, iron and chromium was described by Louis Kahlenberg and K. P. Young at a recent meeting of the American Chemical Society. The following abstract is taken from *Science:*

When ammonium salicylate is added to a dilute solution of an aluminum salt and this solution is then boiled, there separates out in granular form a basic aluminum salicylate of the composition $(Al(C_6H_4.OH.COO)_3)_3.Al(OH)_3$. This may be readily filtered off, washed with hot water, ignited and weighed as $Al_2O_3$. The precipitate is much more readily handled than the usual slimy and gelatinous precipitate of aluminum hydroxide. Zinc, manganese, nickel, cobalt, ferrous iron and chromium are not thus precipitated by ammonium salicylate, which fact is the basis for the direct and simple separation of these metals from aluminum. The solution should be fairly dilute, lest the basic aluminum salicylate occlude notable amounts of the other metals. If this should occur, redissolving the precipitate and then reprecipitating from the dilute solution will secure a good separation. Sodium saliyclate may be used as the precipitant instead of ammonium salicylate, but the latter is preferable.

*American Smelting and Refining Co., Hayden, Ariz.

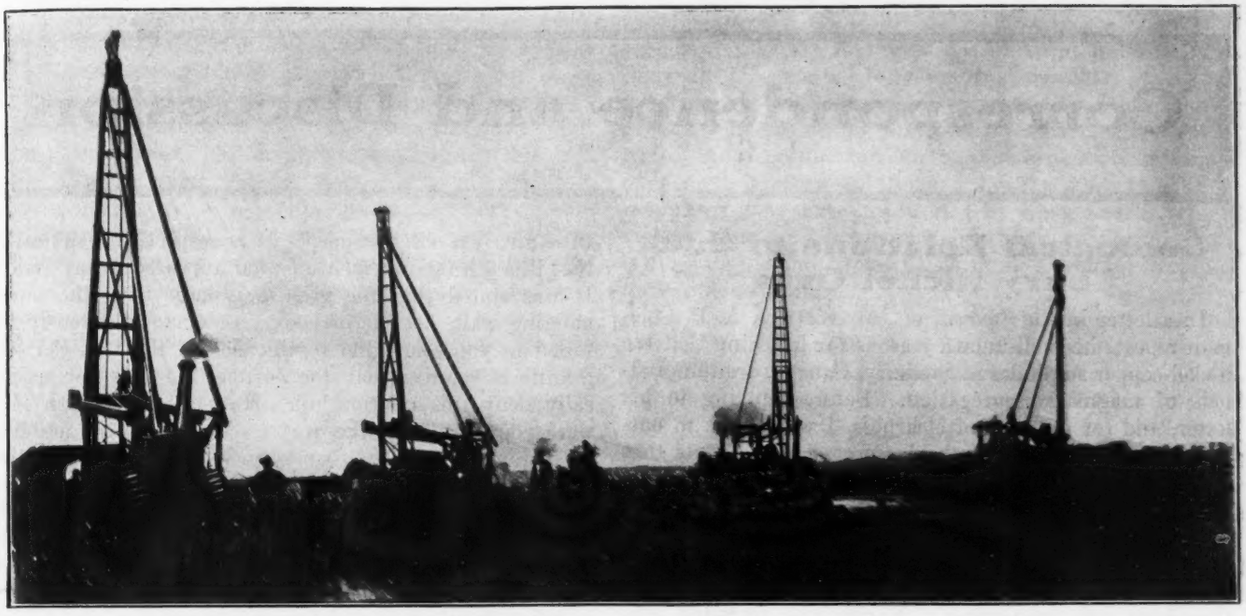
# Photographs from the Field



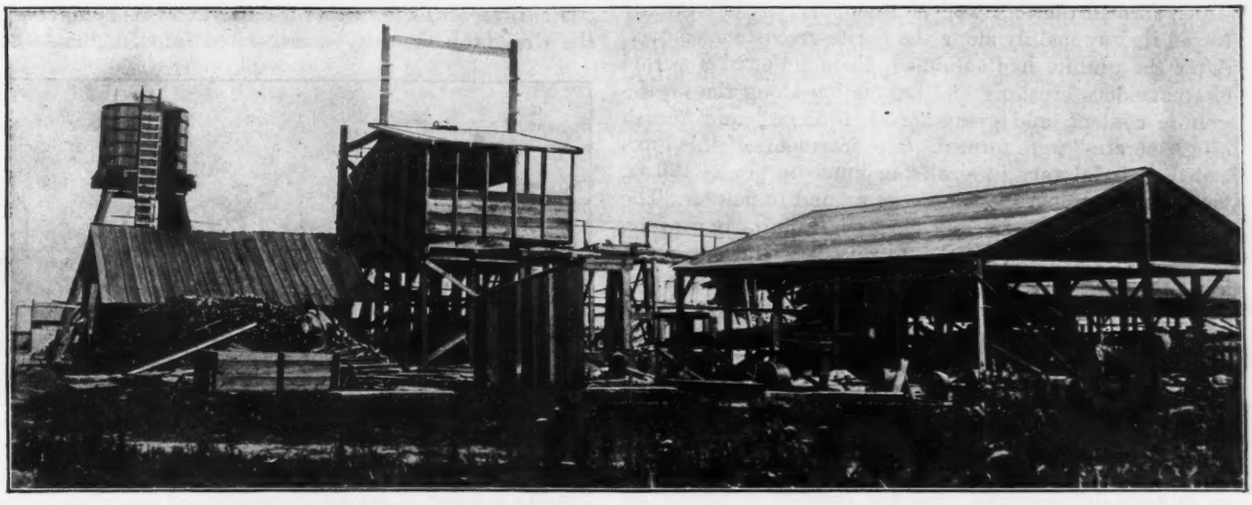
ORKLA MINING CO.'S CUPRIFEROUS PYRITE MINE AT LÖKKEN, NORWAY

New mill and Wallenberg shafthouse in background. The Orkla company, planning an output of 1,000,000 tons per year, let the contract for sinking the Wallenberg shaft to a depth of 1,200 ft. to an American company. The shaft is 12x18 ft., outside of timbers, and was to be sunk at the rate of 20 m. (66 ft.) per month. The E. J. Longyear Co., of Minneapolis, Minn., which took the contract, has averaged over 85 ft. per month, though Norwegian laws prohibit shaft work on Sunday

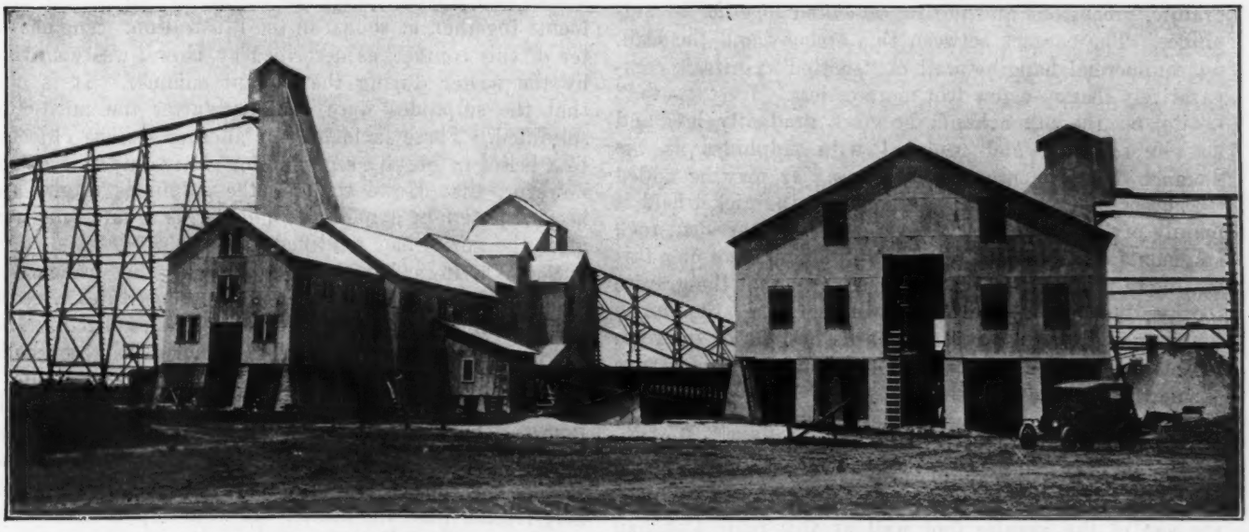
CREW OF THE E. J. LONGYEAR CO. SINKING THE WALLENBERG SHAFT WITH JACKHAMER DRILLS



Not an oil field. Drilling for zinc ore north of Picher, Okla.



The Montreal mine, near Cardin, Okla., one of the richest mines in this field



New Netta mill of Picher Lead Co., Picher, Okla., one of the largest and best in the district

VIEWS IN OKLAHOMA SECTION OF JOPLIN ZINC FIELD. NOW BEING ACTIVELY EXPLOITED

# Correspondence and Discussion

## Geological Relations of Sudbury Nickel Ores

In a letter in the *Journal* of July 8, 1916, A. P. Coleman repeats his well-known reasons for believing that the nickel-copper sulphides at Sudbury, Canada, are the products of magmatic segregation. Before replying to his letter, and for the sake of clearness, I would like to outline again, briefly, the probable succession of events that culminated in the formation of the Creighton orebody. This deposit is selected because it has been considered by many writers as a type example of a magmatic-segregation orebody.

The oldest rocks in the immediate vicinity of the Creighton are greenstones. Norite was intruded into these greenstones. Then came the granite intrusion, which formed the foot wall of the orebody. The granite forced its way mainly along the norite-greenstone contact. After the granite had solidified, there followed a period of tremendous crushing and brecciation along the norite-granite contact, and great "crush breccias" and "crush conglomerates" were formed. The fragments of this brecciated material vary in size from immense blocks 100 ft. long to microscopic specks—rocks ground to powder. The shape of the fragments and blocks is infinite in variety, varying from sharply angular to round. Solutions circulated through the "crush breccia" and "crush conglomerate," depositing sulphides that cemented the fragments together and partly or almost wholly replaced them. Some replacement of the granite foot wall also took place, but the norite hanging wall, particularly where it has been slightly sheared and brecciated, was more severely attacked, often forming what has been called "spotted" norite. In short, the immense stopes of the Creighton mine have demonstrated that the orebody is merely an enormous "breccia" or "conglomerate" of crushed rocks, granite, greenstone and norite, cemented together by sulphides. The contact between this orebody and the lean, noncommercial hanging wall of "spotted" norite is comparatively sharp—a few feet more or less. The "spotted" norite, on the other hand, becomes gradually less and less impregnated and replaced with sulphides as the distance from the orebody increases. It may be added that every other commercial orebody in the nickel field is mainly of this character; that is, a mass of crushed rock fragments cemented together by sulphides. Keeping this outline in mind, and particularly the fact that the granite foot wall at the Creighton is younger than the norite hanging wall, the following remarks may be of interest:

Coleman's letter is in part a criticism of a brief article by me that appeared in the *Journal* of May 6, 1916. In that article it was suggested that deposition of the ores from solution accorded best with the facts. It was further shown that the theory of gravity segregation at the Creighton orebody appeared to be untenable. Regarding the age of the granite foot wall at this mine Coleman remarks: "The statement that the coarse granite beneath the Creighton orebody is later than the ore does not agree with my own observations." It is respectfully submitted that this is a misstatement of what appeared in my article. It was stated that the granite is later than the norite hanging wall, not the orebody. Coleman apparently has failed to appreciate the significance of the fact that the granite is younger than the norite. He does not specifically deny this relationship. He remarks: "Even if it were younger [than the ore] no reason can be assigned why granite should not come beneath an already existing orebody." The reason that can be assigned in the case of the Creighton is that the orebody did not exist when the granite was intruded. The orebody was formed after the intrusion of the granite—a fact to which Coleman assents. This being true, it is easy to realize that molten sulphides in the molten norite could not have settled to the bottom of the norite and rested on a granite that was not there.

E. Howe[1] has shown that the norite, at its contact with the Creighton orebody, is brecciated into fragments and

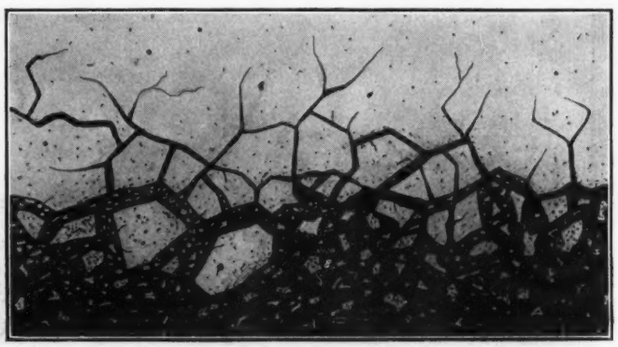


**Fig. 1—Diagrammatic drawing illustrating the character of the contact between massive sulphides (black) and norite (white). Creighton, third level, west end of pit. (After E. Howe.) The nature of this contact presents a serious difficulty to a belief in gravity segregation of the sulphides**

blocks and, further, that the sulphides cement the fragments together, as shown in the illustration. The character of this contact, as described by Howe, was confirmed by the writer during the present summer. It is clear that the sulphides were deposited after the norite had solidified. These facts present another serious objection to a belief in gravity segregation. It is only fair to add, however, that Howe thought the sulphides might have been injected in a molten condition as a later intrusive after the norite had solidified.

Some writers have suggested that the presence of "blebs" of sulphides in fresh norite constitutes a reason for believing that the sulphides crystallized directly from the molten norite. This variety of norite has been called "spotted" norite. Similar "blebs," however, occur in granite, greenstone, greywacke, schist and gneiss, and like the "spotted" norite, "there is no hint of a channel through which the sulphides could have arrived at their present position." The granite is perfectly fresh—probably fresher than the norite. It would appear, therefore, that this method of reasoning loses its significance.

[1] "Economic Geology," September, 1914.

Coleman asks how the origin of the Sultana, Levack, Whistle, Garson and other marginal deposits are to be accounted for in the absence of the "suspicious" granites. I made no suggestion, however, that there was any genetic connection between the granites and the origin of the ores. These deposits were probably formed, like all the other deposits in the area, by solutions circulating along crushed and sheared zones. It is a fact that practically all the orebodies occur along extensive and well-defined lines that have either a northwest-southeast or northeast-southwest direction. These directions constitute lines of shearing and crushing. Some of the deposits in these sheared zones, in the greenstones and sediments, are in part typical fahlbands. It has so happened that the lines of shearing and crushing occur, for the most part, along the contact of the norite and adjacent rocks, thus accounting for the occurrence of the orebodies in this position. It is believed that this explanation of the occurrence of the deposits at or near the edge of the norite is a more rational one than that which suggests that the ores settled by gravity segregation to the edge of the norite.

The theory of gravity segregation at Sudbury is partly based on the plausible supposition that the norite occurs in the form of a sill. The sill-like nature, however, of this intrusive has not been definitely proved. Many of its contacts with adjacent rocks suggest an irregular dike-like form more than a sill-like form.

After all is said, however, the two theories of the origin of the ores—magmatic segregation and deposition from solution—are not, fundamentally, so very far apart. Both have, for instance, a common starting point. That is to say, both agree that the norite and the ore-bearing solutions had a common origin—possibly a deep-seated reservoir of molten rock. The theories merely differ as to how the ores gained their present position. Indeed, Coleman admits that deposition from solution was the dominant factor in the formation of the Worthington and Vermilion deposits. To quote his own words: "Finally there are a few deposits accompanied by little norite . . . such as the Worthington and Vermilion mines, which may have been formed principally through the action of heated water circulating along fissures at distances, sometimes miles, away from the edge of the eruptive sheet."[2] Possibly, therefore, certain writers may come to believe that deposition from solution was the dominant factor in the formation of all the commercial orebodies, including the Creighton.

Coleman refers to my citation of the opponents of magmatic segregation as rather unfortunate. He asserts that "C. W. Dickson, one of the earliest opponents of the theory, called on me some years ago, spent several hours with the microscope over my thin sections of pyrrhotite-norite from Creighton and elsewhere, and could not deny that they favored the magmatic theory." Regarding this statement I am in receipt of a letter from Dickson. "With reference to the Sudbury ores," Dickson writes, "you can if you wish quote me as saying most emphatically that I still am and, since my investigations, always have been firmly convinced that these ores have been mainly depositions from solution. I remember calling on Dr. Coleman several years ago, and we talked about Sudbury ores, and I looked at a few of his slides; but Dr. Coleman is quite in error when he says I came away favoring magmatic segregation. As a matter of fact I spent quite a short time with him, not several hours; and the slides he showed me could not have impressed me greatly, as I have never given up my contention that these ores have been concentrated and deposited in their present formation by means of heated aqueous solutions. To try and twist any remarks I may have made at that time, and of which neither of us can have more than a hazy recollection now, is quite unfair and does not look to me as coming from an unprejudiced mind."

On three occasions in the last eight years it was my privilege to go over the nickel field with Coleman. Nevertheless I should be glad to do so again.

Sudbury, Aug. 20, 1916. CYRIL W. KNIGHT.

[2]Ontario Bureau of Mines, Vol. 14, Part III, p. 19.

## Cattlemen Menace Prospecting

The discussion published so far in the *Journal* has failed to touch upon a point vitally affecting the whole future of mining—the illegal fencing off of mineral lands. Inasmuch as this constitutes a most effective discouragement to prospecting, it is certainly in order to here briefly present the facts.

Throughout the Southwest, at the present time, the prospector is continually obstructed in his ligitimate travels by the ubiquitous landhog, apparently delighting in the unrestrained fencing off of the public domain. The evil is no longer to be mainly attributed to the big cattle interests, but usually to the smaller kind of man, with the upkeep of only a couple dozen cows or so as his sole excuse for encumbering the earth. Near the mining camps, which of course now afford first-class markets for milk and wood, the evil is especially pronounced. On the outskirts of the camp, say, is a water hole that for generations has befriended the steady stream of prospectors and their jacks. Now comes some milk peddler and locates a mining claim so as to include the water hole. Starting with one claim as a nucleus, he locates three or four more around it in the form of a cross or an H. Then he runs a 5-strand barbed-wire fence around the whole area, including not only that staked as mining claims, but all other that can be included.

If this wire-stringer leaves any gates at all, he is sure to keep them locked or posts "No Admission" signs.

With neither water nor pasture for his beasts nor wood for his fires, the prospector is in a bad way. The only way out is to keep his beasts in town, and anyone with the cash to do that probably is not a true prospector. It is unnecessary to remark upon the restraint from prospecting upon fenced lands, as that is obvious.

To make the situation rankle worse, however, the prospector knows that the lands are not legitimately held for farming purposes, but are very largely fraudulently held by mining-claim locations. If the assessment work is properly done the first year, it rarely is in succeeding years, and evasion by well-known methods is only too easy under existing statutes.

I will venture to say that in the Southwest today, 60% of the unpatented mineral lands are held by fences of wood hawkers and milk peddlers who keep the legitimate prospectors out. At the present rate of encroachment, inside of three years it will be impossible to go anywhere within five miles of a mining camp without cutting wire fences. JAMES A. MCKENNA.

Hanover, N. M., Sept. 11, 1916.

## How To Sell a Mine

I have been much interested in reading the article by F. F. Sharpless, in the *Journal* of Aug. 19, 1916, about the way to sell a mine. In the directions given he is without doubt right—when one has a mine to sell. The interesting part of this discussion, it seems to me, is that the question at issue is not so much that of selling a mine as it is interesting capital in the business of mining.

One having a mine to sell is in the same position as any vendor of merchandise. He has so much ore in sight and developed and it is worth so much money, upon which figures of the value of the mine may be predicated. The valuation is a specific matter that may, by process of calculation, be arrived at. I feel that this is the position taken by Mr. Sharpless and, however correct he may be, it does not answer the question of how to sell mining properties, many of which have very little ore in sight, but by systematic development work, based upon favorable geological conditions only, may become properties worth many millions. It is my impression that the origin of the question is as to the means of interesting capital in prospects of merit that may become mines by judicious development.

We all know what Mark Twain said about the prospector: "A liar with a 10-ft. hole in the ground"; but I am wondering if he would really feel like so condemning the prospectors who persistently maintained their contentions of the presence of large deposits of ore—afterward proved to exist—against the scientific knowledge of ore deposits as understood by those skilled in that study. We have instances galore where men of knowledge and learning have repeatedly reported adversely upon properties that afterward became our heaviest producers. In nearly every instance the mines that are our greatest dividend payers owe a debt of gratitude to the pioneer prospectors who persisted in their endeavors and refused to be influenced by the advice of experts on ore deposits.

Not a mine exists today, that was not once a prospect, and many offered little encouragement to the student of ore deposits. In relatively few instances has successful development been due to the presence of the professional student of ore deposits. These men appear in due time and serve a good purpose. Imagine the owner of a partly developed prospect trying to induce capital to join in the development of his property! And yet, if these prospects are not developed we shall soon cease to have mines. Without physical data to measure orebodies presumed to exist, the question is, How are you going to evolve a mathematical calculation that will determine the value of a mine in its early days?

The prospector is interested in advice about how best to accomplish that which will aid him to produce results in the development of his property. He is quite as much interested as the mine owner who has holdings well developed and who is seeking additional capital. Crude as the prospector's ideas of finance may be; wild as his propositions may seem; unlearned in technical expression as he usually is ignorant, as he often is, as to geology and ore formation—yet this is the man who leads the way, and any advice that will help him in his efforts to finance his undertakings would be welcome to him and an aid to the mining industry.

The exploration of promising prospects is a business in itself, distinct and separate from the development of mines. It is a speculative business, but a field that offers great profits if properly managed. The number of prospects presenting favorable surface indications that finally develop into mines of consequence is such that the proportion of successful ventures may safely be said to be greater than in many lines of trade. The wonder, then, is that more encouragement is not given to the financing of prospecting companies. One cannot forecast with precision the future of such companies; nevertheless, results would be more gratifying if persistence were shown and operations extended over a long period of time.

It frequently happens that mining engineers and geologists in their travels come across promising prospects, not sufficiently developed to appear attractive to their principals because there are no ore reserves to measure, but which might appeal by reason of their surface indications. If they attempted to develop such properties they would subject themselves to criticism by their clients, which naturally makes them hesitate. The consequence is that many favorable prospects are without the support they should have. What remedy there is and what means are available for aiding the pioneer in the development of promising prospects are questions of vital importance to the future welfare of the mining industry.

Many of the going mines have men in the field looking for developed properties. Once in an age one is found that conforms to all of the conditions. In all such investigations the men in the field must, by virture of precedent and instruction from headquarters, pay respect only to tonnage developed and value thereof, before exhibiting any interest in other factors. Even though the surface evidence is of such character that it presents especially attractive signs of mineral deposition; even though the district be one of considerable area; even though geology may speak in its silent manner and beckon—yet because there are no measurable orebodies the mining engineer must turn his back and leave.

Now and then we read about the great number of mines presented to this or that mining company; and of these only a few are investigated, out of which possibly one or two may be selected to develop. Is it reasonable to believe that this company has passed intelligently on all these properties, or is it more reasonable to assume that the sifting was done with a sieve with too large a mesh?

Wherein lies the trouble? Is it that conservatism is too conservative? Is not now the time for the exploration of prospects, and is it not compatible with reason that profits may be expected from a sorting of the dumps of prospects that have been rejected by those agencies whose methods are so rigid as to condemn to perdition many worthy prospects? JOHN T. REID.

Lovelock, Nev., Aug. 22, 1916.

## Right To Drill Through Lands

Before Judge Crow, of the Circuit Court of St. Clair County, Illinois, the New Staunton Coal Co. applied for an injunction on Aug. 28 to prevent Louis Miller, of Staunton, Ill., from drilling through their coal vein about 100 yd. in advance of the mine workings at their coal mine at Livingston, Ill. After able presentation of both sides, the judge refused the injunction and granted Miller the right to drill through the coal owned by the coal company by reason of his having leased the privilege from the owner of the surface. H. A. WHEELER.

St. Louis, Mo., Sept. 2, 1916.

# The Rand's Ore Reserves

By A. Cooper Key*

Ore reserves of producing and developing mines of the Rand at the end of last year reveal a total in the neighborhood of 95,000,000 tons, of which about 25% has a value of between 25s. 6d. and 27s. 6d. per ton, or about the present average yield. The total is subject to the sorting out of waste rock, say 10%, before being sent to the reduction works; it embraces ore partly developed, as well as shaft pillars, etc., and therefore not immediately available for stoping. The tables presented herewith show tonnages and values as at Dec. 31, 1915, and 1914, or at the close of the financial year in certain instances. The Rand has had lately an abundance of native labor, which has enabled development operations to be pushed as much as possible and other work to be done that can only be carried out when the supply of native labor is in excess of requirements for essential mining operations.

### One Thousand Less Rock Drills Employed

It is, however, rock drills which produced large developed tonnages, and it is a very distinct feature of recent statistics that the number of rock drills working has shown persistent diminution, a drop of 1,000 machines in the last twelve months. There is nothing to show the distribution of the total number of machines as between development and stoping. Undoubtedly there would be a tendency to employ surplus native labor on development work, and so retain it on the Rand, in order to make the position assured and to provide against the inevitable reduction in the supply. Rock drills would also be taken off stoping work in the narrower orebodies and native labor substituted.

It should be made clear that the two sets of figures are not always comparable; in particular, all the mines of the Johannesburg Consolidated Investment group state their ore reserves in terms of stoping tons and thus come into line with other groups. Hitherto certain of the companies of the group have given their reserves in milling tons. Engineers generally prefer the mining-ton basis, as it can easily be adjusted to milling tons, in accordance with prevailing native labor conditions, sorting ratio and so forth. On the whole the variations at mines with established milling equipments—that is, where increases in reduction plant are not contemplated—are inconsiderable. An exception exists in the East Rand Proprietary, which records a shrinkage of 600,000 tons attributable to low pay ratio; while the Crown Mines aggregate is down only 84,000 tons, explained by a reduction of a couple of inches in the stoping width. But it is distinctly disappointing to find that the ore reserve is only maintained in face of an advance of 50%—that is, from 32,700 ft. to 48,300 ft.—in linear development accomplished. There is this redeeming feature, that the augmented footage produced 637,000 additional payable tons compared with the previous year, whereas the unpayable tonnage developed was almost identical with that of the earlier period. Owing to the alteration in form in which the data are presented, it is not practicable to compare the figures of the Randfontein Central, the third big consolidation of the Rand.

As might be expected, the largest increases are in expanding mines of the far East Rand. Thus the Modder Government Areas, which is doubling its reduction plant, records an increase of 1,214,000 tons (equal to over 50%) and an increase equal to 1.1 dwt. in value and of 8 in. thickness. Some 10,000 ft. developed last year showed 71s. 6d. over 4 ft. of reef thickness. Springs Mines where crushing should begin at the end of the year, has been able to double its tonnage in reserve, the value improving 0.1 dwt. and the thickness by 5 in. Brakpan is distinguished by showing the biggest increase in value, one of 1.15 dwt., which moreover, applies to the huge reserve of three million tons, an advance of 527,000.

THE RAND'S ORE RESERVES IN 1914 AND 1915

| Producing Co. | As at December, 1914. * Tons | Dwt. | In. | As at December, 1915. * Tons | Dwt. | In. |
|---|---|---|---|---|---|---|
| Aurora West | 614,610 | 5.26 | 44 | 550,044 | 5.5 | 42.5 |
| | | | | partial 88,500 | 5.7 | 42.5 |
| Bantjes Con | (b) 800,400 | 6.1 | 41 | (b) 648,000 | 6.1 | 41 |
| Brakpan | 2,490,000 | 6.73 | 62 | 3,017,000 | 7.86 | 62 |
| City Deep | (b) 2,510,800 | 9.7 | 55 | (b) 2,976,800 | 9.5 | 57 |
| City and Suburban | 758,700 | 8.5 | .. | 637,400 | 9.0 | .. |
| Con. Langlagte | (c) 2,220,707 | 6.9 | .. | (c) 2,248,656 | 6.5 | 49.24 |
| Cons. Main Reef | 693,460 | 7.3 | 49 | 855,600 | 7.53 | 48.5 |
| Crown Mines | (b) 10,022,000 | 6.0 | 66 | (b) 9,938,000 | 6.25 | 63.8 |
| Durban Rood. Deep | (b) 1,303,400 | 6.7 | 47 | (b) 1,290,000 | 6.5 | 47 |
| East Rand Prop. | 5,400,000 | 6.6 | 55 | 4,800,000 | 6.3 | 55 |
| Ferreira Deep | (b) 1,893,100 | 8.5 | 68 | 1,854,100 | 8.3 | 70 |
| Geduld Proprietary | 1,900,000 | 7.1 | 59.5 | 2,100,000 | 7.7 | 59.5 |
| Geldenhuis Deep | (b) 1,613,000 | 6.4 | .. | 1,826,800 | 6.1 | 57 |
| Ginsberg | 278,213 | 6.7 | .. | (c) 278,118 | 5.67 | 68 |
| Glencairn | 440,520 (a) | 3.3 | .. | (c) 117,430 | 4.4 | 56 |
| Govt. Areas (Modder) | (c) 2,451,581 | 5.8 | 60 | (c) 3,665,000 | 6.9 | 68 |
| Jupiter | 1,273,000 | 4.5 | .. | (g) 1,217,000 | 4.6 | .. |
| | partial 161,000 | 4.1 | .. | partial 161,000 | 4.25 | .. |
| Knights Central | 430,500 | 5.7 | 63 | 406,400 | 5.8 | 62.4 |
| Knights Deep | (c) 2,480,000 | 4.2 | .. | 2,627,000 | 4.25 | .. |
| | partial 200,000 | 3.9 | .. | partial 174,000 | 3.9 | .. |
| Langlaagte Estate | 886,396 | 5.97 | 50 | 1,161,119 | 6.08 | 50 |
| | prob. 187,221 | | .. | | | |
| Luipaardsvlei Estate | 660,365 | 5.5 | .. | 702,123 | 5.3 | .. |
| Main Reef West | 526,440 | 5.7 | 53 | 416,280 | 5.87 | 51 |
| Meyer & Charlton | 469,839 | 13.9 | 55 | 485,246 | 12.56 | 53 |
| | | | | partial 46,566 | 19.87 | 47 |
| Modder B | 2,772,540 | 8.6 | 55 | 2,790,740 | 8.75 | 56 |
| Modder Deep | 2,450,000 | 8 | 69 | 2,670,000 | 8.3 | 73 |
| New Goch | 825,900 | 5.27 | 84 | 668,600 | 5.51 | 82 |
| New Heriot | 588,315 | 8.1 | .. | 536,680 | 8.2 | .. |
| New Kleinfontein | (c) (f) 2,890,731 | 5.6 | 58 | (c) (f) 2,846,712 | 5.5 | 57 |
| New Modderfontein | (b) 6,334,500 | 8.4 | 63 | 6,010,800 | 8.15 | 62 |
| | | | | (h) 1,656,000 | 6.6 | .. |
| New Primrose | 335,463 | 6.8 | .. | (c) 265,623 | 5.5 | 56 |
| New Unified | 371,037 (a) | 5.5 | .. | (c) 399,140 | 5.7 | 44 |
| Nourse Mines | (b) 2,473,700 | 6.4 | .. | (b) 2,952,400 | 5.7 | .. |
| Princess Estate | 553,000 | 7.1 | 28.2 | 488,000 | 6.7 | 29.7 |
| RandfonteinCentral | 6,826,644 | 6.6 | .. | (i) 4,449,324 | 7.4 | .. |
| | | | | (j) 3,285,153 | 4.2 | 5.3 |
| Robinson, Leader & S. Reef | 364,700 | 10.7 | .. | 565,100 | .. | .. |
| Robinson Reclaimable | 330,100 | .. | .. | | | |
| Robinson, Main R. | 534,300 | 4.4 | .. | 418,200 | .. | .. |
| Rose Deep | (b) 3,957,100 | 5.5 | .. | (b) 3,605,390 | 5.2 | 62 |
| Robinson Deep | (c) 1,533,000 | 5.9 | .. | 1,513,000 | 6.0 | .. |
| | partial 407,000 | 5.8 | .. | partial 365,000 | 6.1 | .. |
| Roodepoort United | 590,000 | 5.9 | 45 | 720,309 | 5.9 | 44 |
| | partial 227,000 | 5.9 | 45 | partial 148,414 | 5.17 | 48 |
| Simmer & Jack | (c) 2,320,000 | 5.4 | .. | 2,155,000 | 5.2 | .. |
| | partial 348,000 | 4.6 | .. | partial 273,000 | 4.3 | .. |
| Simmer Deep | 1,429,000 | 4.3 | .. | 1,585,000 | 4.4 | .. |
| | partial 302,000 | 4.6 | .. | partial 238,000 | 4.4 | .. |
| Van Ryn | 1,973,312 | 6.5 | 53 | 1,953,000 | 6.2 | 54 |
| Van Ryn Deep | (c) 1,692,349 (a) | 8.5 | .. | (c) 2,044,108 | 8.4 | 62 |
| Village Deep | (b) 2,853,470 | 6.8 | 60 | (b) 2,631,606 | 6.6 | 60 |
| West Rand Cons. | 1,453,000 | 6.05 | 49 | 1,838,380 | 6.1 | 52 |
| | partial 340,000 | 7 | .. | partial 255,793 | 6.4 | .. |
| Witwatersrand | (c) 1,221,879 (a) | 6.6 | .. | (c) 1,480,423 | 6.83 | 60.4 |
| WitwatersrandDeep | 1,707,400 | 6.2 | 50 | 1,673,300 | 6.02 | 54.5 |
| Wolhuter | 999,400 | 5.9 | 53 | 1,263,320 | 5.8 | 53.2 |
| Non-Crushing Co. | | | | | | |
| Cinderella Cons. | 613,000 | 6.35 | .. | | unchanged | |
| | partial 231,000 | | | | | |
| Developing Co.: | | | | | | |
| Springs Mines | 553,000 | 10.3 | 52 | 1,125,000 | 10.4 | 57 |

* Or latest date in respective years. (a) Estimated recovery value. (b) Includes shaft and boundary pillars. (c) Mining tons. (d) Payable and unpayable. (e) Milling tons. (f) Includes Apex and Benoni, Kleinfontein Section alone, 1,781,231 tons, 5.47 dwt. over 59 ft. 6 in. (g) Of the total, 303,000 tons at the Catlin shaft not economically available. (h) At circular shaft. (i) Payable. (j) Unpayable at present costs.

New Modder's reserve outside the circular-shaft section shows a drop of 325,000 tons, the value being ¼ dwt. lower. Circular-shaft development is shown for the first time at an approximate total of 1,656,000 tons, which cannot of course be credited to a single year's work. City Deep has brought up its reserve by 460,000 tons, coupled with a slight decrease in value.

Allowing for sorting, Van Ryn Deep's reserve is 100,000 tons to the good, while the present stoping value

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approximates to the former milling value. At the Geduld Proprietary Mines the reserve has increased 200,000 tons and the value has improved by 0.6 dwt. Modder Deep's value is 0.3 dwt. higher, its total (220,000 tons) more due to greater thickness. Meyer & Charlton is now the only producing mine on the Rand whose reserve is over 10 dwt. in value, that assigned to the complete development being 12.56 dwt., while that partly opened is worth nearly an ounce. Springs, at 10.4 dwt., is second, but this is at present a developing mine. The Robinson's leader and South Reef Reserve used to be valued at over 10 dwt., but values are no longer assigned. City Deep and City Suburban are the only representatives of 9 dwt. grade. Rose Deep's reserve has dropped 352,000 tons, the value being 0.3 dwt. owing to consistently poor development. Nourse mines aggregate has increased 480,000 tons, but the value has seriously deteriorated. Among West Rand concerns, the Consolidated increase of nearly 500,000 tons in two years and the Roodepoort United's 350,000 tons (and 0.6 dwt. in value) are noteworthy.

## Breach of Ore-Sales Contracts

By A. L. H. Street*

A suit for damages for breach of a contract for the sale of the output of zinc concentrates at a smelting company's plant, under which it was agreed that average quotation of the *Engineering and Mining Journal* for spelter at East St. Louis during the month of arrival at the buyer's works was to be taken as a basis for settlement, was lately decided in plaintiff's favor. (Jacobsen vs. Tri-Bullion Smelting and Development Co., 233 Federal Reporter, 646.)

In affirming judgment for $5,847.31 in favor of plaintiff, the United States Circuit Court of Appeals, Second Circuit, holds that if plaintiff was unable to procure elsewhere the same kind of ore to take the place of that which defendant failed to deliver under its contract, the damages recoverable for breach of the contract are to be measured with reference to the market value of the best substitute available.

It is also decided in the same case that the fact that plaintiff failed to make a small payment due on a delivery made did not justify defendant in terminating the contract; it appearing that plaintiff customarily had been permitted to make settlements when convenient, and was responsible for its obligations, that the particular payment fell due after defendant announced its repudiation of the contract, and that plaintiff was fairly entitled to retain the payment to offset damages for such breach.

## Tolovana Gold Gravels, Alaska

During 1914 and 1915 hundreds of people, attracted by the reported finding of gold in the headwater region of Tolovana River, in central Alaska, rushed into the district, and systematic mining began there during the summer of 1915. Although considerable prospecting was done, only about 10 mines were commercially productive, but these made a gold output to the value of $80,000. Gold-bearing gravels occur in the beds of the present streams, in buried channels and in bench gravels, but most of the gold has been won from the deep channels on Livengood Creek, which have proved to be far richer than either the stream or the bench placers. Some shallow placers have also yielded gold, notably on Olive Creek, but only prospects have been found in the benches.

A report by A. H. Brooks entitled "Preliminary Report on the Tolovana District, Alaska," has been issued recently by the United States Geological Survey, Bulletin 642-G. This report will be distributed on requests addressed to the Director, United States Geological Survey, Washington, D. C.

## Arizona Meeting of A. I. M. E.

Editorial Correspondence

*(By Telegraph)*

The Arizona meeting of the American Institute of Mining Engineers, from all reports so far received as the *Journal* goes to press, is proving one of the best attended and most successful ever held by the Institute.

The party leaving New York on Sept. 14 numbered only 17, but received recruits at Albany, Utica, Chicago and Kansas City, so that over 50 arrived at Chicago. Here they were met at the station by automobiles and taken on a sight-seeing trip to the city parks, followed by a banquet at the Hotel La Salle. The special train leaving Chicago for El Paso carried the private car "Anaconda" of Vice-President Benjamin B. Thayer of the Anaconda Copper Mining Co.

Arrived at El Paso Sunday afternoon, the party was greatly swelled by the addition of the Arizona delegation, whose members welcomed the Eastern delegates to the Southwest. The party was conducted on a trip of inspection to El Paso smelting works under the leadership of Karl Eilers. The entertainment committee, headed by Mr. and Mrs. W. W. Rose and Mr. and Mrs. W. D. Gordon, conducted the delegates on tours about the city and to the National Guard camps at Fort Bliss. The party was characterized by high spirits, and a number of staid Eastern delegates were treated to experiences never before enjoyed. One young lady, a graduate of the chemical engineering course of Boston Tech, visited and apparently enjoyed a spectacular bull fight at Juarez. In the evening the party, now numbering 180 guests, sat down to a Mexican dinner at the Toltec Club, where the menu included the following items: Enchiladas con huevos, tamales de pollo, tortillas, frijoles refritos, nieve neapolitana, queso and café. A Mexican orchestra enlivened the evening by playing Mexican airs.

This train out of El Paso consisted of 14 cars including the club car and stateroom car. The number of delegates ariving at Santa Rita was 105. Here Manager J. M. Sully, his wife and daughter, assisted by many officials of the Chino and Empire Zinc companies, were responsible for a most unique and enjoyable program. While the arrangements showed much thought and work, Mr. Sully modestly disclaims any credit for it,, saying that he had nothing to do with it except to tell his boys to go as far as they liked. The first thing on the program was a trip around the Chino steam-shovel pits. All clambered aboard a special train of bunting-bedecked flat cars and took this most enjoyable trip. The party then split, part descending into the pits for closer inspection of the porphyry ores, going thence to the Fierro iron mine and the new Chino mine crushing plant. The rest

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journeyed by automobile to the new 100-ton mill and mine of the Empire Zinc Co., at Hanover. The reunion of the parties was celebrated on the return to Santa Rita at noon by a barbecue enlivened with military airs played by the United States cavalry band from Fort Bayard.

Leaving Santa Rita by automobiles, the visitors were taken to the Chino mill at Hurley, where it so happened that Manager Daniel C. Jackling was due to arrive the next day to decide important questions pertaining to future new operations. In speaking of this expected arrival, L. D. Ricketts voiced the general feeling concerning the Jackling accomplishments. He said that while Jackling was at first considered somewhat wild in his endeavors, now he has everyone looking for 1½% ore.

### Flotation Plant at Chino

Construction of a new flotation plant has been started at the Chino concentrator to re-treat all the stored mill tailings. The crushing plant at the mine is being enlarged to double its capacity. For this purpose a great jaw crusher is being built, the opening of which is 5x7 ft. and its weight over 400,000 lb. Other improvements include new boiler units at the power plant, water-cooling towers and a weighing system attached to the conveyor belts for weighing the flotation tailings directly as they come from the Portland filters.

On returning from the Chino mill, as the train came down the track it stopped at a spot brilliantly lighted near a pavilion erected for the occasion, where a dance was held up to the time of departure for Douglas at 10:15 p.m. At both Santa Rita and Hurley the ladies' entertainment commitees did much to add to the pleasure of the visits. At Santa Rita the committee consisted of Mrs. Horace Moses and Mrs. F. J. Anderson. The Hurley committee consisted of Mesdames F. R. Wicks, G. L. Webster, S. B. Riser, J. F. Anton, J. W. McElvany, Newton Holman, F. M. Brown, R. C. Thompson and David Boise.

Upon arrival at Douglas early Tuesday morning the delegates were met by a military band and transported in automobiles to the Copper Queen smeltery, where a thorough inspection was made before going on by train to the Calumet & Arizona smeltery. Here the new acid plant attracted greatest attention. Its walls and roof are finished and the lead chambers are now being installed. A buffet lunch was given under the blast-furnace dust chamber—a significant commentary on the cleanliness of the plant. Enjoyment was added at this point by the military music played by the artillery band. Both the Copper Queen and Calumet & Arizona companies distributed finely illustrated booklets describing their respective plants and giving data concerning production.

The first technical session of the meetings was called to order at 2 o'clock in the Y. M. C. A. gymnasium, with 175 delegates in attendance, the ladies being conspicuous by their absence. They had been urged to attend by President L. D. Ricketts, but had deserted in a body to enjoy the superior attractions of what is humorously referred to by the men as a "tea fight." The session was opened by President Ricketts, who called upon Walter Douglas to preside. Manager J. C. Greenway of the Calumet & Arizona company, made an address of cordial welcome to Arizona, to which President Ricketts of the Institute responded briefly, "passing the buck" as he termed it, to President Thayer of the Anaconda company, a past president of the Institute. The assembly voted a tribute to James Douglas, from whom a telegram had been received and read.

The subject of this first session was the general one of smelting. More copper-smelting plant construction has been witnessed in Arizona during the past five years than in any like period of the world's history. This statement was made by A. G. McGregor, of Warren, Ariz., in an address on the "New Copper-Smelting Plants in Arizona." Mr. McGregor said that in this period five new plants had been constructed whose monthly production ranges from 5,000,000 to 18,000,000 lb of copper. He described new features in plant design and equipment recently developed. Discussion of McGregor's paper brought from L. D. Ricketts a statement that the preventable loss of recoverable copper due to splashes from a converter during blowing and due to dusting in the charging system is 0.70%. E. P. Mathewson expressed himself as impressed by the cleanliness of the plants visited, the skull crackers, the ventilation system, the provisions made for the safety and health of the men, the convenient plant arrangement and modern steelwork construction.

### The Basic-Lined Converter

A paper entitled "The Basic-Lined Converter in the Southwest" was presented by L. O. Howard. Discussion of this paper brought out the fact that 70,000,000 lb. of copper has been blown with one basic converter lining owing to its excellent grade of material and to the fact that Howard practically lived with it day and night. E. P. Mathewson said that the disadvantage of the Anaconda type of converter was the considerable splashing, unless care is taken in its operation, due to its deeper placement of tuyeres. The disadvantage of the Peirce-Smith type of converter is the difficulty in getting the silica evenly distributed over the bath of matte. He said that with the Anaconda type, if the heat is kept down to reasonable limits by careful operation, the lining will last almost indefinitely. The superintendent of El Paso smeltery said that the company's old 11-ft. Smith type of converter used 11,000 cu.ft. of air, while the new type of 35-ft. Smith converter used 30,000 cu.ft. of air.

At the evening session, Doctor Morse, of the Western Precipitation Co., presided, the session being devoted to the subject of "Leaching." Frederick Laist and Harold W. Aldrich described the 2,000-ton leaching plant at Anaconda, Mont. "Possibilities in the Wet Treatment of Copper Concentrates" was the title of a paper by Lawrence Addicks, while "Leaching Tests at New Cornelia" was discussed by H. W. Morse and H. A. Tobelmann.

This paper brought out considerable discussion in which Mr. Van Arsdale advanced the opposite view regarding anodes. F. N. Flynn, of the Arizona Copper Co., made the important announcement that the company would start leaching raw flotation concentrates without roasting. He commended the Chino process of dissolving copper by sulphuric acid, then precipitating the copper with iron followed by floating the copper.

**"The Modern Hospital,"** published from St. Louis and Chicago, devotes its August issue to a symposium on welfare work among the industrial corporations of the country. The journal contains many illustrations of welfare features in corporation plants, and many facts that should be of great help to those interested. Among the topics discussed are those of first aid, industrial nursing, lunches and diets.

## Dewatering Cobalt Lake

The Cobalt Lake Co., Cobalt, Ont., which is a subsidiary of the Canadian Mining Corporation, undertook to dewater Cobalt Lake, with the object of making accessible ore reserves assumed to exist between the stope-backs and the bottom of the lake. As the water supply for several mills near Cobalt Lake and the Town of Cobalt fire service, as well as several other users depended largely on the water of the lake, an alternative supply had to be provided before undertaking the dewatering. According to the annual report of the company, the plant required for the dewatering of the lake consisted of a 20-in. wire-wound wood-stave pipe line, 3,600 ft. in length, through which water was pumped from Cobalt Lake northerly to Farr Creek; a housed pontoon in the deepest part of the north end of Cobalt Lake, containing two centrifugal pumps and motors of 3,500 gal. per min. each, for the purpose of pumping out Cobalt Lake and keeping it dewatered; two wooden flumes, one on either side of the south end of Cobalt Lake, 2,050 and 1,010 ft. long respectively, for the purpose of conveying the mill tailings and diverting surface water to the sump of the pumping station at the north end of the lake.

The water supply system consisted of a pumphouse on the southwest side of Cobalt Lake, containing two centrifugal fire pumps and motors, each of 600 gal. per min. capacity, and 2,800 ft. of pipe line to Cobalt town. A concrete dam was erected at the north end of Short Lake, 290 ft. long and 20 ft. high for storage water for the mills and fire service. A pumphouse was erected at Short Lake, containing pumps and motors of the following capacities for the water supply of the Cobalt Lake Mill, Cobalt Reduction Co. mill and other mills, and for the fire service: Two centrifugal pumps, 700 gal. per min. each; one centrifugal pump 400 gal. per min., and one centrifugal pump 450 gal. per min. In connection with this service, 5,800 ft. of cast-iron pipe and 600 ft. of spiral steel-riveted pipe was used. A housed pontoon at the north end of North Pickerel Lake, containing one centrifugal motor-driven pump of 3,500 gal. per min. capacity, which discharges through 1,270 ft. 16-in. wire-wound wood-stave pipe, and a closed wooden flume, 1,520 ft. long, into Brief Lake, which empties by a gravity ditch 1,600 ft. long, into Short Lake. A housed pontoon was provided at Bass Lake with one 3,500 gal. per min. centrifugal pump, which discharges through 1,260 ft. of 16-in. wire-wound wood-stave pipe to South Pickerel Lake, which is connected naturally with North Pickerel Lake. Included in the work are several minor dams, cutoff walls and trestle work, also a power line and telephone line. The dewatering of the lake commenced on Apr. 26, 1915, and was completed June 5. To keep the lake dry, the pumps have been operated about half time. On Apr. 19 the water service commenced and was in full operation by Apr. 29. The details of operating costs are given in the table herewith:

DETAIL COST OF DEWATERING COBALT LAKE AND KEEPING IT EMPTY, AND OF NEW WATER-SUPPLY AND LAKE DRAINAGE SERVICES

From Apr. 12, 1915, to Dec. 31, 1915

| Water-Supply | Gallons Pumped | Hours Pumping | Power | | Operation | | | Maintenence and Repairs Pipe Lines and Flumes | | Power Line | | | Superintendence and Other Expenses | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kw.-Hr. | Cost | Labor | Material | Total | Labor | Total | Labor | Material | Total | | |
| Short Lake to Cobalt reduction mill | 340,524,000 | 5,944 | 293,815 | $3,393.79 | $987.19 | $15.68 | $1,002.87 | ..... | ..... | ..... | .... | ..... | ..... | $4,396.66 |
| Cobalt Lake mill | 187,262,450 | 5,666 | 117,010 | 1,363.11 | 393.19 | 6.24 | 399.43 | ..... | ..... | ..... | .... | ..... | ..... | 1,762.54 |
| McKinley-Darragh | 123,161,000 | 5,866 | 111,885 | 1,379.69 | 397.84 | 6.80 | 404.64 | ..... | ..... | ..... | .... | ..... | ..... | 1,784.33 |
| Northern Ontario Light and Power Co. | ..... | .... | ..... | ..... | 46.20 | 147.47 | 193.67 | ..... | ..... | ..... | .... | ..... | $155.46 | 349.13 |
| T. & N. O. Ry. | ..... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .... | ..... | 784.00 | 784.00 |
| Cobalt fire service | ..... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .... | ..... | ..... | ..... |
| Short Lake station | ..... | .... | ..... | ..... | 66.74 | 210.39 | 277.13 | ..... | ..... | ..... | .... | ..... | ..... | 277.13 |
| Pickerel Lake to Brief Lake | 480,676,000 | 2,304 | 167,830 | 2,179.42 | 641.91 | 141.20 | 783.11 | $44.61 | $44.61 | ..... | .... | ..... | ..... | 3,007.14 |
| Bass Lake to Pickerel Lake | 370,619,500 | 2,877 | 170,140 | 2,439.32 | 803.68 | 284.17 | 1,087.85 | ..... | ..... | ..... | .... | ..... | ..... | 3,527.17 |
| Montreal River to Bass Lake | ..... | .... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .... | ..... | ..... | ..... |
| Sundry service | ..... | .... | ..... | ..... | 170.99 | 64.48 | 235.47 | ..... | ..... | $74.10 | $5.66 | $79.76 | 690.50 | 1,005.73 |
| Total | ..... | .... | 860,680 | $10,755.33 | $3,507.74 | $876.43 | $4,384.17 | $44.61 | $44.61 | $74.10 | $5.66 | $79.76 | $1,629.96 | $16,893.83 |
| Lake Drainage | | | | | | | | | | | | | | |
| Cobalt Lake pumping plant | 946,008,000 | 2,590 | 454,700 | $6,849.91 | $2,486.98 | $1,217.15 | $3,704.13 | ..... | ..... | ..... | .... | ..... | ..... | $10,554.04 |
| Surface drainage | ..... | .... | ..... | ..... | ..... | ..... | ..... | $111.65 | $111.65 | ..... | .... | ..... | ..... | 111.65 |
| Sundry | ..... | .... | ..... | ..... | ..... | ..... | ..... | 38.39 | 38.39 | ..... | .... | ..... | ..... | 38.39 |
| Total | ..... | .... | 454,700 | $6,849.91 | $2,486.98 | $1,217.15 | $3,704.13 | $150.04 | $150.04 | ..... | .... | ..... | ..... | $10,704.08 |
| Grand total | ..... | .... | 1,315,380 | $17,605.24 | $5,994.72 | $2,093.58 | $8,088.30 | $194.65 | $194.65 | $74.10 | $5.66 | $79.76 | $1,629.96 | $27,597.91 |

The books of the company show for 1915 an expenditure of $56,222 for Cobalt Lake drainage and $15,520 for Cobalt Lake drainage operation.

## NEW PATENTS

United States patent specifications listed below may be obtained from the "Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

FURNACE—Metallurgical Furnace. Utley Wedge, Ardmore, Penn., assignor to The Furnace Patent Co., Philadelphia, Penn. (U. S. No. 1,195,425; Aug. 22, 1916.)

INGOT-DELIVERY CAR. Albert Soderstrom, Homestead, Penn. (U. S. No. 1,195,522; Aug. 22, 1916.)

IRON ALLOY—Process of Producing an Iron Alloy Rich in Phosphorus from Inferior Finery-Slag. Friedrich von Holt, Georgsmarienhütte, near Osnabrück, Germany. (U. S. No. 1,196,185; Aug. 29, 1916.)

LAMP—Acetylene Lamp. John M. Brock, Brooklyn, N. Y. (U. S. No. 1,193,985; Aug. 8, 1916.)

LEACHING—Method of Extracting Metals from Their Ores. Henry B. Slater, Riverside, Calif. (U. S. No. 1,195,616; Aug. 22, 1916.)

MOLDS—Manufacture of Molds for Steel. Charles G. Robinson, Pittsburgh, Penn., assignor to Harry E. Sheldon, Pittsburgh, Penn. (U. S. No. 1,191,473; July 18, 1916.)

REDUCTION—Art of Reducing Metal Ores and Fusing Other Materials. Charles B. Hillhouse, New York, N. Y. (U. S. No. 1,193,783; Aug. 8, 1916.)

ROASTING FURNACE—Securing Rabble Arms to Shafts. Louis R. Kelley, Philadelphia, Penn., assignor to the Furnace Patent Co., Greenwich Point, Philadelphia, Penn. (U. S. No. 1,195,360; Aug. 22, 1916.)

STAMP MILL. Richard Raycraft, Genoa, Nev. (U. S. No. 1,195,855; Aug. 22, 1916.)

STEEL—Method of Producing Steel and High-Phosphorus Slag. Anson W. Allen and Eugene Guy Lilly, Birmingham, Ala. (U. S. No. 1,193,496; Aug. 8, 1916.)

TIN—Improvements in the Electrolytic Refining of Tin. American Smelting and Refining Co., New York, N. Y. (Brit. No. 11,818 of 1915.)

TIN—Process for Removing Iron from Tin Ores. Günzel von Rauschenplat, Steglitz, Germany, assignor to Parilla Ltd., London, England. (U. S. No. 1,196,049; Aug. 29, 1916.)

TITANIC OXIDE—Method of Treating Titanic Oxide. Auguste J. Rossi and Louis E. Barton, Niagara Falls, N. Y., assignors to The Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,196,030; Aug. 29, 1916.)

TITANIUM COMPOUND. Auguste J. Rossi and Louis E. Barton, Niagara Falls, N. Y., assignors to The Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. Nos. 1,196,029 and 1,196,031; Aug. 29, 1916.)

# Editorials

## A Cadmium Myth?

During the last two years, while the spelter market has been so greatly excited, there has been an extraordinary demand for superior spelter and buyers have emphasized the desirability of a minimum content of cadmium. Extremely fine points have been drawn. Certain brands of spelter that in lead and iron content are not inferior to the premier have failed to come into the class of high-grade spelter, owing to the presence of a few hundredths of a per cent. of cadmium, and have therefore been rated as high-grade intermediate, realizing a price far below that of high-grade although far above that of brass special. Producers have striven to supply spelter free or nearly free from cadmium, owing to the demands of buyers. So long as the latter were willing to pay largely for a refinement, it was not for the producer to question whether the refinement was necessary or not. In the minds of manufacturing experts, however, there has long been a doubt whether the objection to cadmium is well founded, and whether indeed it is not mythical.

Many years ago—long before anybody dreamed of the recent extraordinary military demand for spelter—the *Journal* published some editorials on the subject of cadmium in spelter used in brass making, which were based on conferences with and communications from a considerable number of representative brass makers. The conclusion was reached then that a moderate percentage of cadmium—as much as is ever found in any American spelter—was not prejudicial to the use of the metal for brass making. Since the manufacture of cartridge brass has become a major industry we have been told, however, that the spelter for such brass must not contain any cadmium. The latter, it is said, causes the brass to deteriorate in storage, to become porous, likely to split, etc. We should like to know what good evidence there is on this subject. None has come to our attention beyond the mere assertion. As a matter of fact, cartridge brass has been made successfully from spelter containing 0.3 to 0.4% of cadmium. Indeed, when such spelter is used there is no cadmium in the brass, anyhow.

Cartridge brass is ordinarily cast at a temperature considerably above the boiling point of zinc, which is far above the boiling point of cadmium, and the latter element naturally eliminates itself. The most careful analytical work on brass made from spelter containing 0.3 to 0.4% cadmium does not show a trace of cadmium, either qualitatively or quantitatively, in the alloy. If any reliable chemist has facts to the contrary, we should like to hear from him.

Of course, when spelter containing as much as 0.4% of cadmium is used for brass making, the loss in melting is increased by just so much, and the brass maker does not like to pay at spelter price for a metal that he is going to lose inevitably. However, with trifling percentages of the impurity that objection is minimized and, anyway, is not a good reason for the payment of a large premium for the absence of it.

If cadmium can be caused to remain in the brass, which, as previously pointed out, is not the easiest thing to manage, a considerable quantity of it—say 0.75% and upward—has some hardening effect. Furthermore, cadmium and lead occurring together in quantities of that magnitude render the brass somewhat sensitive to heat treatments, on account of the low melting point of alloys that may be formed. Brass of such sorts would have to be made deliberately.

The Zinc Committee of the American Society for Testing Materials is very guarded with respect to its statements regarding cadmium. That committee says: "There is very little doubt but that cadmium in zinc is very injurious for some of the purposes for which it is used, as it renders it harder and much more brittle. There is, however, considerable difference of opinion as to how far these undesirable properties persist in alloys made from zinc containing cadmium. The majority of the brass makers are of the opinion that the high temperature of the brass pots causes so much of the cadmium to volatilize that the residual amount has very little deleterious effect. . . . We have no reliable information at present showing the effect of small amounts of cadmium on the alloys, and the evidence on this point is extremely conflicting."

There is no doubt that even a minute percentage of cadmium is unpermissible in spelter that is to be used for making ornamental castings—"slush castings" as they are called in the factory. Spelter that is practically free from cadmium is also required for galvanizing telegraph and telephone wires that are to withstand sharp bending when making the "lineman's splice," for it has been found that otherwise the coating cracks and peels off the joints. For sheet-zinc rolling also, cadmium in spelter is undesirable, causing such severe cracking that metal containing much of it is not economical. The objectionability of cadmium for those three purposes has been well established. Beyond those nothing has been firmly established. None of the three uses of spelter herein mentioned is a military use. We should like to hear from some military engineers why they are so insistent upon spelter very low in cadmium and what they do with it.

## The Cyaniding of Flotation Concentrates

The problem of cyaniding flotation concentrates has been treated academically a number of times in the technical press, but no one seems to have gone into it thoroughly on an experimental basis. The fact is that up to this time there has been no occasion to regard the matter in other than a theoretical light. It has been realized, of course, that some day the problem will have to be solved, but the real necessity for its solution had not yet appeared.

In the United States the greater portion of ores treated by flotation have been copper, lead and zinc, while few

applications to silver or gold ores have been noted, and even in these cases the situation has been close enough to smelting plants so that there would be no difficulty in shipping the material produced—a cheaper and easier process than attempting to cyanide it. Should flotation be adopted, however, by isolated plants situated far from a railroad and a long way from smelting plants, then the problem is different and has to be solved on its merit. Particularly is this the case with the Mexican silver mills, where silver usually exists as a sulphide, the whole ore heretofore having been treated by the cyanide process.

The experiments upon Santa Gertrudis ores, showing that flotation is a decidedly promising process for those ores, will undoubtedly stimulate application of the process at many other Mexican plants. In many cases they are too far from smelting plants to allow of economical shipment, so that the problem of cyaniding the concentrates produced must be solved.

The first problem in cyaniding flotation concentrates—in fact, the only one—will be a decision as to whether contained oils will be detrimental to cyaniding. If they are, they will have to be eliminated by some means, whether by roasting or by washing out with hot water or alkaline solutions. After that, the cyaniding of flotation concentrates becomes the same as the cyaniding of any other concentrates. Such work has been successfully done at many places, and there is no reason to believe it cannot be done with flotation concentrates, once the question of what effect the oil has in the matter is settled.

## The Taxation of British Mining Companies

It has previously been suggested that the effect of the super-tax on mining companies with head offices in Great Britain and in other warring countries might result in a change of domicile, particularly for companies in which there are large foreign interests. A case in point has just come to our notice. Aramayo Francke Mines, Ltd., has decided to move its main office from London to Geneva, Switzerland. This company has important mines in Bolivia and produces silver, tin, tungsten, bismuth and copper. As some of the principal shareholders reside in other places than in England, it was felt that the super-tax resulting from the war was hardly justified in its application to these holdings, notwithstanding that the company is a registered British corporation. In making the change in headquarters, various neutral countries were considered, including Spain and Argentina; in the former the laws were found to be unsatisfactory, while Buenos Aires was discarded as being too far from the market for the company's products. Switzerland offered all the advantages of other neutral countries, besides favorable laws, practical political isolation and comparative impregnability.

There may be a sentimental or patriotic objection on the part of British shareholders to removing the headquarters of the company to Switzerland, but as a matter of fact there will be a slight financial benefit to them in this change, inasmuch as the heavy war taxes will not be deducted in Switzerland from the general profits available for dividends, though British holdings will of course still be subject to income tax and dividends will be paid, as heretofore, ex-income tax. It seems unlikely that any companies operating in the warring empires will be able to change their headquarters to elude taxes, as it is probable that such a movement would be prohibited or new regulations enforced to collect the equivalent taxes at the source of production. However, in the case of companies operating in foreign countries and in which there is a considerable foreign interest, there are sound reasons for the change of headquarters.

## China as an Exporter of Ores and Metals

The report of exports from China, as given by the Imperial Maritime Customs, shows some interesting things as to how that country is gradually entering the markets of the world with its exports of ores and metal. Most important, in point of value, is tin, the exportation of which in 1915 amounted to 8,825 tons, compared with 7,948 tons in the previous year. Next in importance is antimony. Of the metal there was exported in 1915, 25,746 tons, compared with 21,648 in the previous year. On the other hand, the exportation of ore declined from 5,479 tons in 1914 to 1,843 tons in 1915, this reflecting the increased tendency of the Chinese to smelt their ore at home. China has now become the most important of the world's producers of antimony.

China is making small exports of iron, lead, lead ore and quicksilver, but she imports a great deal more lead than she exports, and she imports a good deal of copper, which she does not export at all. The Chinese imports of iron and steel are chiefly the manufactures thereof. Very interesting is the report respecting zinc. Of zinc ore there was exported 8,126 tons in 1914 and 9,415 tons in 1915; of spelter, 342 tons in 1914 and 2,566 tons in 1915; of all other forms of zinc, 2,175 tons in 1914 and 9,872 tons in 1915. Respecting the last we do not understand what forms of zinc are meant. The fact that China should be exporting any zinc is interesting. Probably it comes from the small native furnaces, the prototypes of the art, that we have mentioned in recent articles. Japan has already become a rather important producer of spelter. China may become so in the not distant future. The enterprise of the leading Chinese mining and metallurgical men is well exemplified by the fact that they produce antimony by better methods than prevail anywhere except at a few works in France.

## Some Thoughts About Foreign Investments

Foreign mine owners in Mexico are now threatened with a new danger by Carranza, who proposes to increase to a confiscatory rate taxes on developed mines in certain districts if not put into operation within 60 days, the ostensible purpose being to give employment to idle Mexicans. American companies have appealed to the State Department to protest against the new decree, but what good is going to do? There is not a company owning a mine in Mexico, we venture to say, that would not like to work it if it dared.

In no similar period in the history of the United States has so much legislation been enacted with the possibility of such far-reaching effect on the foreign relations and trade of the country as in the last two weeks, says a con-

temporary. This legislation is in the Shipping Board law, passed by Congress Aug. 30 and signed by the President on Sept. 7, and in the Omnibus Revenue bill, passed by Congress Sept. 8 and now awaiting the signature of the President.

We believe it is true that the present administration has been making strenuous efforts to extend American trade in foreign countries. Suppose it succeeded in doing so within a year, and then in some country—Bœotia, let us say—anarchy developed—like that in Mexico—would it tell American investors that they went there at their own risk and there be nothing to do about it?

## BY THE WAY

A cargo of copper, which was said to be the largest ever shipped here, was brought into this port yesterday by the American steamer "Sherman," on her arrival from Valparaiso, Antofagasta and Cristobal, says the New York *Sun,* Sept. 17, 1916. The shipment, which consisted of refined product, was valued at more than $4,000,000. It weighed 5,500 tons and was shipped in care of the American Smelters Steamship Co.

The romance of mining, like the glamor of soldiering, is rapidly becoming a thing of the past. On Sept. 14 prohibition was adopted in the Yukon Territory by popular vote, and it is noted with some surprise that the largest majorities in its favor were in the mining districts. The disappearance of the typical miner of the old school, as depicted by Bret Harte and Service, recklessly blowing in his gold dust in the saloons, dancehouses and gambling dens, is doubtless due to the exhaustion of the placer mines and the adoption of modern methods under which the working miners' possibilities of sudden enrichment have vanished.

Two mining scholarships, said to be the first of the kind in England and worth £60 a year each, are to be established by the Weardale Lead Co. According to the *Financial Times,* the object is to combine university training with a year's practical work, calculated to advance the student in the knowledge of mining engineering. One of the scholarships is at the Royal School of Mines and the other at Armstrong College, Newcastle. The Weardale Lead Co. owns a lease of lead mines and smelting works near Weardale, Durham, and produces about 4,000 tons of pig lead yearly. The lease embraces an area of 80 sq.mi. and is for sixty years from 1883.

In a crowd of job "rustlers" surrounding a Butte shaft the other day stood a typical Swede. Inwardly concerned as to how he should hold down a job if successful, he was intently observing the details of work about the shaft. In the pursuit of such useful details as might come handy, he followed a trammer as he pushed a car of waste to the dump. The trammer was apparently nervous, for the car under observation escaped his control and went over the dump just as the foreman came along. With characteristic Celtic decision, the boss promptly fired the trammer on the spot and grabbed the first man handy to fill his place. So the Swede suddenly acquired a job, and the foreman headed for the office in blissful confidence. A half-hour later that confidence was rudely jolted by hearing at his elbow in Swedish drawl, "Aye say, boss—you bane got any more dose leedle wagons?" Hasty investigation enlightened the boss that, working true to his one observation, the Swede had loaded all the cars at the shaft one by one and pushed them over the dump.

The author of an article in the *Journal,* some time ago, made use of the metaphor, "between the devil and the deep sea," but said that a mill operator was "literally" in that position. This called forth a protest from England, in the following form:

"If he was literally there, both devil and deep sea must have been visible. You should have given a photograph—an authentic likeness of Satan would be interesting. Seriously, when I see people misuse the word 'literally' in this way, I, as part owner of the English language, feel as if someone had used my best razor to chop firewood. For there is, literally, no other word which can do the work of 'literally,' and habitual misuse of it threatens to leave us with no word at all to do its work. For instance, in most quarrels 'there are faults on both sides' metaphorically, but at the Menai Straits there are literally 'faults on both sides,' geological faults."

Very true—but, isn't the example a little "faulty"? How many kinds of faults are there, and isn't one just as "literal" as the other? However, "be to her faults a little blind!"

An ex-mining broker was being bombarded with arguments from a man who had read the article of a prominent economist on conditions after the war, says the *Evening Post.* After the man had finished, the ex-mining broker, little suspected of entertaining thoughts on anything outside his narrow field, replied: "You have omitted the most important economic effect of the war. I mean its effect on character. You will remember that before our Civil War the South was in a backward state, and even the North was not so greatly advanced industrially. But when the armies of the South and North were mobilized, there came into those armies men who had followed a plow or had stood behind a counter in a small shop. These men were rustics; many of them had ability, a few of them had genius; but that ability and that genius had lain dormant, because the men were tied to their daily routine or lacked the courage to start afresh. The war broke violently into this routine; contact with men from other parts of the country tore down provincialism; the men learned of other opportunities; and when the war came to a close these men were compelled to make a fresh start. They did it. They went West. They built up the railroads. They started new enterprises. They had gained the courage, the nerve, which formerly they had lacked. The same thing is happening in Europe. Rustics are fighting side by side with men of the cities; most of the men have traveled farther from home than they have ever been before. They are no longer rustics; they are cosmopolitans. To a backward, largely agricultural country like Russia this means much. I should not be surprised if after the war we were to see in these countries a great moral and intellectual, which must ultimately be a great industrial, awakening. What that will mean for our industry and our foreign trade it is difficult to say, but the effect will not be small."

## PERSONALS

**Lloyd E. LeDuc** has gone to Vanadium, Colo., from Arizona.

**C. V. Rodes** has gone from Joplin, Mo., to Charleston, W. Va.

**D. P. Mitchell** is expected to arrive in New York in October.

**Elwin L. Smith** recently at Granby, Mo., is now at Ray, Arizona.

**G. H. Cox** lately at Rolla, Mo., is now located at Tulsa, Oklahoma.

**B. S. Harrold** is now at Westover, Va. He was recently at Skagway, Alaska.

**Ellard W. Carson** is now with the Alpine Quicksilver Mining Co. at Hernandez, Calif.

**H. H. Knox** is about to sail for England, whence he will go to Siberia on professional work that will occupy him about three months.

**Arthur K. Adams,** recently of El Paso, Tex., has been appointed geologist for the Andes Copper Co. and has sailed for Chañaral, Chile.

**Edwin S. Berry,** who has joined Pope Yeatman as a partner, sailed for Peru Sept. 16 in connection with mine examination work in that country.

**W. H. Staver** has moved his office to 1412 Massachusetts Ave., Washington, D. C. Mr. Staver has been examining mining properties near Silver Plume, Colo.

**Fred Hellman,** general manager of the Chile Copper Co., has been appointed consulting engineer by the firm of Guggenheim Brothers, succeeding Pope Yeatman.

**Samuel D. Nicholson,** manager of the Western Mining Co., Leadville, who has been a candidate for the republican nomination for governor of Colorado, was defeated at the state primaries.

**Lyon Smith** has resigned his position as metallurgist with the Snyder Electric Furnace Co., of Chicago, to become assistant superintendent for the River Smelting and Refining Co., Florence, Colorado.

**G. H. Cunningham** has resigned his position as superintendent of construction with the Anaconda Copper Mining Co. to become chief engineer for the Electrolytic Zinc Co., of Australia, at Hobart, Tasmania.

**Professor Lawrence Martin,** of the University of Wisconsin, assisted by F. T. Thwaites, had a class of 22 men doing field work in geology and geography in the Devil's Lake region (Wis.), during the month of August.

**W. L. Honnold,** the well-known mining engineer, who has been assisting Mr. Hoover in the Belgian relief, has come to New York to succeed Capt. J. F. Lucey as director of the Commission in America. Mr. Honnold is quoted as saying: "If the children of Belgium and northern France are to grow to healthy maturity, they must be provided with more food than is now supplied to them, and to this end the Commission for Relief in Belgium will soon ask the people of the United States to give at least $1,000,000 monthly toward the cost of a special meal which will be served every day in the schools." Just before he sailed for America, Mr. Honnold inspected conditions in the occupied areas and he says that the Commission must increase its activities on behalf of the children, and, particularly, must combat an alarming increase of tubercular troubles among both children and adults.

## OBITUARY

**Alexander Watson Bluck** died at his home in Pittsburgh, Sept. 17, aged 69 years. He was born and educated in Pittsburgh and was actively engaged in steel manufacturing until his retirement from business a few years ago. He was for 20 years with the Park Brothers Steel Co., being general manager for a large part of the time. He was one of the organizers of the Pittsburgh Crucible Steel Co., and for some years a director. He was a member of the Pittsburgh Club and was connected with several charitable organizations.

**John V. Beekman,** for many years connected with the Lidgerwood Manufacturing Co., died at his home in Plainfield, N. J., Sept. 11, aged 73 years. Mr. Beekman was born at Somerville, N. J. About 1870 he engaged in the manufacture of rotary engines, pumps, etc., being a member of the firm of John A. Lighthall, Beekman & Co., with works at Imlay St., Brooklyn, N. Y. This company was absorbed by the Lidgerwood Manufacturing Co. in 1873, Mr. Beekman assuming charge of the works of that company. He was the inventor of many improvements in hoisting engine design. Mr. Beekman gradually withdrew from active participation in business about 10 years ago, devoting his later years to outdoor pleasures, becoming an enthusiastic motorist and golfer, being a member of several golf clubs, and a familiar figure on the golf course at Pinehurst, N. C., where he spent his winters. For many years Mr. Beekman had been a member of the American Society of Mechanical Engineers. His death is keenly felt by his surviving family, and by many of the men with whom he was formerly associated.

## SOCIETIES

**National Safety Council**—The annual meeting and congress will take place in Detroit Oct. 17 to 20. We have received a copy of the program—40 pages long—and containing the names of 140 speakers. The development of the Council's work has indicated the need for intensive study of the problems of various industries, so that the main feature of the meeting this year is Sectional conferences. For instance, the Mining Section will meet Oct. 18 and 19, with H. M. Wilson of Pittsburgh as chairman and H. M. Wolflin of the Bureau of Mines as secretary.

**Institute of Metals**—At the annual meeting in London, Sept. 20, Sir George T. Beilby presided and the following papers were read and discussed: (1) "The Allotropy of Silver." By Dr. W. D. Helderman, Utrecht University, Holland. (2) Note on "Cadmium in Spelter." By W. R. Ingalls, New York. (3) "The Annealing of Arsenical Brass containing 61 and 62.5% of copper. A Study of the Structure and Properties Developed by Varying the Rate of Cooling within the Transformation Range." By C. H. Mathewson and E. M. Thalheimer, Yale University, U. S. (4) "The Development of the Spelter Industry." By Ernest A. Smith, Sheffield, England.

## INDUSTRIAL NEWS

From Sept. 5 the offices of the Pacific Tank and Pipe Co., the National Mill and Lumber Co. and the Mercantile Box Co. are again at the old location, No. 318 Market St., San Francisco.

The **Brennan Engineering Co.,** Chicago announces that the business has been incorporated under the name of the Brennan Wahl Co., consulting engineers. Daniel A. Brennan is president; Andrew G. Schneider, vice-president; Henry R. Wahl, secretary-treasurer.

**Hammond Iron Works,** Warren, Penn., has made an arrangement with Wonham, Bates and Good, 17 Battery Place, New York, by which the latter represent the Hammond Iron Works in Cuba, Argentina, Brazil and British Columbia. The Hammond Iron Works manufactures steel tanks and general steel plate work.

## TRADE CATALOGS

**Jaw Crushers.** Traylor Engineering & Mfg. Co., Allentown, Penn. Bulletin J-1. Pp. 22; 7x9½ in.; illustrated.

**Pelton-Doble Centrifugal Pumps.** The Pelton Water Wheel Co., San Francisco, Calif. Bulletin No. 9. Pp. 8; 6x9 in.; illustrated.

**Welding and Cutting Equipment.** Searchlight Co., 415 Karpen Building, Chicago, Ill. Catalog No. 12. Pp. 32; 6x9 in.; illustrated.

**Grinding Machinery.** Colorado Iron Works Co., Denver, Colo. Pamphlet No. 31. Pp. 32; 6x9 in. Describes ball and tube mills, grinding pans, etc.

**"Ironclad-Exide" Battery for Storage Battery Mine and Industrial Locomotives.** The Electric Storage Battery Co., Philadelphia, Penn. Bulletin No. 159. Pp. 8; 8x10½ in.; illustrated.

**Burd Piston Ring Directory.** Burd High Compression Ring Co., Rockford, Ill. 1916 Edition of piston ring sizes for automobiles, trucks, tractors, engines, etc. Pp. 180; 4½x6½ in.; illustrated.

**"Better Electric Motors."** S. K. F. Ball Bearing Co., Hartford, Conn. This is the title of a pamphlet which describes the application of S. K. F. bearings to electrical machinery. Pp. 62; 6x9 in.; illustrated.

**Fuel Oil Appliances.** W. S. Rockwell Co., 50 Church St., New York. Bulletin No. 31. Pp. 28; 8½x11 in. This contains considerable information on the burning and handling of fuel oil which ought to be useful to those interested.

# Editorial Correspondence

**SAN FRANCISCO—Sept. 13**

**Gold Dredging Is Active** in all the California fields and a number of the established companies are adding to their gold fleets. Construction on Yuba No. 16 is to be started this month and Pacific No. 5, a Guggenheim boat, near Smartsville, has been launched and construction is going forward. The Guggenheim interests are prospecting some ground on the north fork of the American River, near Auburn. The situation on middle fork of the American River, near Auburn, where a Guggenheim dredge and the Poverty Flat dredge are operating, is worth looking into again. At Chico a Guggenheim dredge and the Wade dredge are operating. At Oroville, the Natomas Co. has started prospecting the tailings with a view of ascertaining whether it will be worth while to redredge a part of the Oroville field. At Natoma, old No. 1, which is being rebuilt, is nearly ready for commission; No. 4 which was reconstructed with two tailing stackers has been improved and is now successfully doing the work of reclamation; a number of Natomas dredges are being equipped with Neill jigs in accordance with the installation on No. 7; this boat turned over a while ago but has since been righted.

**BUTTE—Sept. 14**

**Anaconda's New Zinc Plant** at Great Falls was sufficiently completed to place the first section of the electrolytic refinery in operation on Sept. 11. Construction was begun last December and could have been completed in August, but for delay in delivery of machinery and steel. When completed the plant will have a capacity of 70,000,000 lb. of zinc annually and will have cost about $2,000,000.

**Supply of Labor Is More Plentiful,** with the advent of cold weather. The usual rush of men into Butte has begun. Every day the line of "rustlers" at the various mines is lengthening and more men are seeking jobs at present than at any time for months. Many of the rustlers are old-time miners who during summer work in the hayfields for the sake of being out in the open. These men, as a rule, get their places back. But among the applicants are hundreds of men who have never been in a mine and have drifted into Butte, attracted by the prevailing high wages and in the hope of finding employment in the mines. As there are plenty of men in Butte for the work now being done, the influx of job seekers has swelled the number of unemployed and unemployable in Butte to a high point.

**The Mine Experiment-Station Site** for the Northwest still remains undecided. While no definite announcement has been made as to the final location of the station, Butte is among the sites under consideration, offering as it does besides local advantages, the laboratory facilities and other equipment at the School of Mines as well as the aid of the students. Those in charge of the station would find these advantages of great assistance in carrying on the work contemplated by this department of the government. Moreover, the many interesting problems to be solved every day in the normal operations of the Butte mines and the reduction works at Anaconda and Great Falls, would present a constant stimulus for most interesting research work. While Butte is too busy with its own multitudinous tasks to make a formal campaign to obtain the station, if selected as the site, it wil give its hearty support to those in charge of the station.

**Barnes-King Prospects** are again interesting stockholders who have had a long period of gloom. Officers of the Barnes-King Development Co. are well satisfied with conditions at the properties and the showing made in the new mines, but the passing of the dividend and the decreased earnings shown by the monthly statements are not so encouraging to stockholders. The last report shows that the estimated value of the bullion produced in August was $330,000 from 2,511 tons of ore, the North Moccasin mine yielding $15,000 from 1,713 tons and the Piegan-Gloster and Shannon mines $18,000 from 1,300 tons of ore. There has been no improvement in the bottom workings of the North Moccasin, where the vein has been narrow and of low grade for several weeks, but it is stated that the showing in the upper workings is better than a month ago. The winze from the 500-ft. level of the Gloster was unwatered and the 498 ft. of old workings at the bottom—300 ft. below the 500-ft. level—were cleaned up and sampled, but the appearances were not encouraging. The west drift on the 400 was driven 141 ft. during the month, and for the last 30 ft. the ore assayed $8 per ton for a width of 4½ ft. The rope tramway at the Shannon mine is in operation and a good production from the property may now be expected, according to the official statement. The wagon road from the Woodrow Wilson mine to the county road, a distance of 3 mi., has been completed and shipments of ore from that property began on Sept. 1. Nothing is being done at the old Barnes-King mine, which adjoins that of the North Moccasin in the Kendall district.

**DENVER—Sept. 12**

**Specimen Identification** will be continued at the Colorado School of Mines, but free assaying was discontinued on Sept. 1. A year ago there was established a fund providing for a department for testing and identifying specimens sent in by prospectors. During the first year more than 5,000 samples and specimens were thus classified or assayed. The duties of the department became so great that most of the fund has been exhausted and no assaying is now being done, although specimens will be identified and statements will be written concerning the probable commercial value of each sample submitted.

**Tungsten Mining** continues a prominent industry in Boulder County although it does not possess the glamor it had a year ago. A prominent assayer in Boulder, however, reports that his office still does a heavy business in tungsten assays. This indicates that prospectors and leasers are paying closer attention to the grade of ore they select for shipment and have become economical, instead of profligate, as formerly, in saving and seeking only high grades. The Degge-Clark tungsten mill in Boulder Cañon is operating at capacity although this and the other mills do not turn out as large quantities of concentrates since they have been operating on lower grade ores.

**Safety Rules for the Cripple Creek District** have been published by Mine Inspector M. J. McCarthy. The list is a long one and includes, among other requirements, the following: Winzes and raises must have at least two compartments; hoisting conveyances must not be filled to overflowing; wooden buildings must never be erected over mine mouths; ventilation must be ample; safety clutches, detaching hooks and automatic engine-stops must be installed; worked-out stopes parallel to working stopes must be filled with waste; landings at not to exceed 20 ft. apart must be placed in all ladderways; bulkheads and chain ladders must be provided in bottoms of all shafts and winzes during sinking; solid doors instead of guard rails must be erected at shaft collars and at shaft stations.

**LEADVILLE, COLO.—Sept. 15**

**Another Gold Dredge** is to be installed near Leadville. John R. Champion, former superintendent of the Yak Mining, Milling and Tunnel Co., has completed plans for the operation of a dredge in the mouth of Iowa Gulch. Prospect shafts of from 10 to 15 ft. in depth are reported to have indicated values of 45c. to $1.50 a yard. The problem of securing sufficient water to float the boat is now delaying the enterprise, but Mr. Champion has stated that this will be taken care of in some way within the coming month. The Champion dredge will be the second to enter Lake County. The boat now being operated by the Derry Ranch Gold Dredging Co. on Box Creek has proved to be a remarkable success, and the gravel at the mouth of Iowa Gulch is claimed to be equal to that being dredged on the old Derry ranch.

**Sluicing in California Gulch at Leadville** is again in progress but the objective is quite different from the one that caused the settlement of this district a half century ago. Today, zinc and lead minerals are sought and gold is no longer uppermost in the thought of Leadville's residents. A small group of Leadville men, headed by Dr. Max Raabe, a practicing dentist, has been testing the alluvials in California Gulch, practically within the city's limits; and enough of the ground has been handled to prove that it can be made the basis for successful commercial operations—upon a relatively small scale to be true. These men have a long lease upon a fairly large tract of this gulch extending from below the site of the dismantled Union smeltery up to the big trestle of the Colorado Midland R.R. Beside proving the value

of the loose ground by test pits spaced 50 ft. apart, several carloads of concentrate have been recovered by the simplest kind of apparatus. A small sluice supplies creek water for a small two-compartment jig into which is fed the alluvial material without any sorting or screening. The efficiency is low, the concentrates averaging only about 20% zinc and 6% lead. Experiments are being made to increase the capacity of the project as well as to improve the recovery. It is believed that the installation of simple, standard types of concentrators and some devices for breaking up the compacted gravel, sand and minerals will be sufficient. Within a short time, it is expected that a steady production of 40% zinc concentrates will be the result of this project. Three different types of jigs have been tried, each machine driven by a small gasoline engine. The minerals—sphalerite and galena—unquestionably came down the gulch from the mills near the portal of the Yak tunnel. Interesting facts concerning this "tertiary" enrichment are that the sulphide minerals are not on bedrock and, despite their exposure to weather, are practically unoxidized.

**Empire Zinc Co.** on Oct. 1 will take over the active operation of the large area of mining property purchased last summer from the Small Hopes-Boreel Mining Co., including the Robert Emmet, McCormick, Ranchero, and Gonabrod claims in Stray Horse Gulch. This tract is in one of the promising sections of the district; since the draining of the territory was recently completed through the Wolftone shaft by the Empire Zinc Co. and the Western Mining Co., it offers unlimited possibilities for deep mining. At present the Robert Emmet is shipping 100 tons of high-grade zinc-lead ore daily. It is stated that the orebodies now open in this property are the largest in the district with the possible exception of the Garbutt. The Empire Zinc Co., which is under the local management of Charles Bargler, has erected a new surface plant and installed new electric-hoisting machinery at the McCormick shaft. A request has just been made of the Denver & Rio Grande Ry. to lay 600 ft. of standard-gage track to the McCormick to handle the large tonnage of ore that is to be shipped beginning early next month. After all preparations have been completed it is reported that the Emmet and McCormick will ship a combined tonnage exceeding that of any property in the district.

### SALT LAKE CITY—Sept. 15

**Utah Coal Mines** are at present receiving more orders than at any time in three years, according to production reports being received by J. E. Pettit, state coal-mine inspector. Difficulty is experienced by some of the mines in getting enough cars to move their output. Prices of coal recently submitted by Salt Lake dealers to the board of education were: Lump, $5.75; nut, $5.25; screened slack, $3; dust, $2.50.

**The Cottonwoods and American Fork** are receiving more attention from the United States Geological Survey. F. S. Ransome, geologist in charge of the Economic Branch of the Survey, is in Alta supervising and working out some of the more difficult geology with B. S. Butler, who has been on the ground for some time. A thorough report with detailed work on some of the complicated structural features of the district will be welcomed by the Utah mining men.

**New High Records by Utah Copper Co.** were attained during August, both in the mining and milling departments. On one day 45,275 tons of ore were mined and loaded on the cars. The Magna and Arthur mills, which were built to handle 12,000 and 8,000 tons respectively, handled in one day 40,300 tons or about twice their rated capacity. The average tonnage milled during the month was 36,000 tons daily, and the ore and overburden handled averaged 67,000 tons a day for the month.

**Bondholders' Reorganization Plan for Ohio Copper** has been sent to stockholders by the bondholders' protective committee, 43 Exchange Place, New York. A substantial cash royalty has been accumulated, and the bondholders now find themselves in a position to reorganize and readjust the affairs of the company. The plan of reorganization adopted by the bondholders, June 8, 1916, provides that the bondholders in exchange for their bonds and coupons will receive bonds and stock of the new company to be organized as follows. Seventy-five per cent. of the principal in new bonds and 25% of the principal in new stock. The bondholders of the Bingham Central Ry. Co. shall be given the privilege of participating on the basis of 46½% of the principal of their bonds. Stockholders of the Ohio Copper Co. or Bingham Central Ry. Co. are given a right to subscribe at par, and accrued interest, for an aggregate of at least $250,000 in bonds of the new company and with the bonds will receive a bonus of 1½ shares of stock of the new company, par value $1, for each dollar of bonds so subscribed and allotted. The bonds will be registered 6% income bonds, which may become convertible into stock at par at such time as the committee shall determine. At least 25% of the net income of the new company shall be applied annually in payment of the principal of the bonds outstanding. Any stockholder who desires to avail himself of the privilege of subscribing for these new bonds may exercise his privilege by depositing his stock indorsed in blank with the secretary of the committee, H. G. Catrow, and at the same time paying in cash 10% of the face amount of bonds subscribed for. If the committee is unable to carry out the plan it will return to any deposting stockholders any certificate delivered to it together with the cash received from such stockholders, with interest at rate which shall have been allowed thereon by its bank of deposit. The right to accept the plan expires Sept. 30, 1916. Stockholders in New York are endeavoring to get together and start action in behalf of the minority stockholders. The majority stockholders are also the majority bondholders. Stockholders in Salt Lake met Sept. 14, over 50,000 shares being represented. An outline of the troubles of the company as issued by the North American Liquidation Co., behind the move of the stockholders, was read, and the meeting asked for suggestions as to what action should be taken. A committee consisting of George Baglin, J. R. Whitney, and W. M. Havenor, was appointed. This committee met later and chose Frank B. Cook as the representative of local stockholders. The committee will urge all local stockholders to coöperate on whatever plan of action is decided on. Stockholders' meetings are to be held today in both New York and Boston.

### JOPLIN—Sept. 16

**Record Ore Sales** from the veteran Oronogo camp were claimed during the week by the Oronogo Mutual Co. It sold a total of more than one million pounds of blende and galena, all of which had been made by one mill in two weeks' run.

**Rivalry in Ore Hoisting** between two mines of the Kenefick Zinc Corporation, the Coyote and Airedale, resulted in the establishment of a new record here last week. The mines are on adjoining tracts, and when the Airedale recently hoisted 890 cans (1,250 lb. each) with a 72-hp. electric hoist, the Coyote workers began speeding up and two days later pulled 890 cans. On Thursday last the miners at the Airedale set out to beat this record and from 7:30 a.m. to 4 p.m.—with a half-hour off for lunch, a strict 8-hr. day—raised 1,017 of the 1,250 lb. cans. The tub hooker, Roxie Fisher, missed but two cans out of this number and upset three, and one shoveler loaded 83 of the cans and another 82. The company took notice of the performance by a special luncheon for the men on Saturday afternoon.

### DULUTH, MINN.—Sept. 16

**The Largest Iron-Ore Cargo from Ashland, Wis.,** was sent out on Sept. 8 when the steamer "M. A. Ford" cleared with 12,861 tons. The 1916 tonnage of iron ore, thus far, exceeds the total 1915 shipments from the Ashland docks.

**Peat Fields in Northwestern Minnesota** are to be the subject of an exhaustive examination, conducted by State experts in coöperation with local authorities. Senator D. P. O'Neill of Thief River Falls is to be in charge of the investigations.

**Universal Portland Cement Co.'s Plant** will be in full operation within two weeks. Three of the four kilns are now operating and the daily output of the plant is 3,000 bbl. Electrostatic precipitators are being installed to prevent the escape of the cement dust.

**Fatality Rate for Iron Miners in Itasca County,** Minnesota, is reported upon by the mine inspector for the year ended June 30, 1916; there was but one fatal accident for each 1,067,000 tons of iron ore shipped from the county, which includes the western end of the Mesabi Range.

**Collapse of Cuyuna Range Strike** was officially completed at a recent meeting of the Industrial Workers of the World at Crosby, Minn., when it was unanimously decided to call off the strike. The miners had called it off some time prior, as all mines in the district are operating regularly. There is, however, a shortage of miners due to so many having left the district during the strike troubles.

### TORONTO—Sept. 15

**The Dominion Royal Commission,** inquiring into the resources of the British Colonies, visited Cobalt on Sept. 7, the party including Sir Edgar Bowring, Sir George Foster, W. Lorimer, Joseph Tatlow and others, accompanied by Thomas W. Gibson, Deputy Minister of Mines for Ontario. They were officially welcomed by Mayor McKinnon, and were met by a committee of mine managers who furnished them with the information required. After visiting several of the principal mines they left for Porcupine, whence they will proceed to British Columbia.

# The Mining News

## ARIZONA

### Cochise County

SHATTUCK-ARIZONA (Bisbee)—Shipping about 600 tons daily, of which 50 tons are lead ore and the remainder copper. Development in Copper Rock claim on 800 level has added considerably to sulphide-ore tonnage, about 75 tons of 5% copper ore being mined daily from this ground.

### Gila County

MIAMI MOTHER LODE COPPER (Miami)—Development is being undertaken at this property, about 8 mi. west of Miami; comprises about 980 acres between Inspiration Needles and Five Point Mountain. Several shallow shafts; principal work on the Cracker Jim which is 142 ft. deep, with some lateral work. William Schaefer in charge.

CHRISTMAS (Christmas)—This copper mine, which is only 8 mi. from the Hayden smeltery, has not been acquired by the American Smelting and Refining Co., as mentioned on p. 514 of the "Journal" of Sept. 16. It is merely operated by the Smelting company under an agreement and is still owned by the Gila Copper Sulphide Co. S. H. Sherman is superintendent.

### Maricopa County

NORTH MARICOPA GOLD (Phoenix)—Reopening old Union mine under direction of Herbert Strickland. Evans shaft is being unwatered with a view of developing Evans vein and crosscutting to old Union vein.

### Mohave County

FIRST PLACER LEASE in Oatman district has started operations on Warner group. Men are making better than wages but are having difficulty in separating pyrite from the gold and are sinking a shaft for water.

TOM REED (Oatman)—Strike in Aztec claim on 400-ft. level is reported.

GOLD DUST (Oatman)—New mill being tried out, including new centrifugal separator.

HIDDEN TREASURE (Chloride)— Another strike of high-grade ore made in this property.

OATMAN AMALGAMATED (Oatman)—Driving crosscuts east and west in low-grade material at 300-ft. level.

KEYSTONE (Chloride)—Excavations about completed for new mill. Sinking continues, a 12-ft. vein having been cut near the 300-ft. level.

OATMAN NORTH STAR (Oatman)—Work has been resumed after five weeks shutdown, due to lack of funds. R. R. Moore, superintendent.

### Yavapai County

NEW STATE (Prescott)—Air compressor and drills being added. W. S. Wilhelm, manager.

GOLD BLOSSOM (Prescott)—Will sink 200-ft. shaft to 500-ft. point. Air compressor and hoist being installed. F. A. Johnson, in charge.

STODDARD MILLING (Stoddard)—Made initial shipments of concentrates to Humboldt smeltery on Aug. 23. Treats ores of Stoddard and Copper Queen mines.

CALUMET & JEROME (Jerome)—This property, about 1 mi. south of Jerome, is to be further developed by Boston and New York men. Workings include 100-ft. shaft and a 1,000-ft. tunnel.

UNITED VERDE CONSOLIDATED COPPER (Jerome)—This company, which recently acquired the Mahurin property, 4 mi. southwest of Camp Verde, has also taken over the United Verde Junior group of six claims surrounded by the Green Monster, Verde Combination, Decatur and News groups.

## CALIFORNIA

### Amador County

MOST AMADOR COUNTY GOLD MINES CLOSED on Sept. 19 by failure of underground men to report for work, by order of United Federation because mine operators declined to discuss uniform scale.

### Nevada County

ADVANCE OF 25C. PER DAY in wages was announced for Oct. 1 by principal mines in Grass Valley, including North Star, Empire Mines, Brunswick, Golden Center, Allison Ranch, Sultana and Union Hill.

### Sierra County

GRAY EAGLE (Downieville)—Heavier power machinery being installed, stamp mill being moved to obviate long tram, and work resumed on oreshoot in shaft. Sidney C. Love in charge.

SIXTEEN-TO-ONE (Alleghany)—Under agreement with Twenty-One mine, work resumed in litigated ground, under direction of experts of both companies, to determine ownership of veins in dispute.

HERKIMER (Downieville)—Channel, sought for years struck 900 ft. from tunnel mouth; gravel yielding $6 to $8 per carload. Under bond to Gustav De Bretteville, of San Francisco. A. B. Cary, foreman.

ROCK CREEK (Downieville)—This gravel mine has opened extension of rich Bald Mountain channel. Strike made in 65-ft. raise near face of 1,000 tunnel at west rim, with 8,000 ft. of channel to be worked; gold steadily growing coarser and more plentiful. W. F. Copeland in charge.

### Tulare County

INTERNATIONAL MAGNESITE (Porterville)—This San Diego company has purchased property of California Magnesite Co. here and will complete the calcining plant.

## COLORADO

### Arapahoe County

OIL AT AURORA was struck in well 3,130 ft. deep. Amount as yet uncertain and small.

### Clear Creek County

GEM ELECTRIC CO. (Idaho Springs)—Purchased at sheriff's sale all property of Boston-Colorado Power Co. and will continue to operate plants.

CAPITAL (Georgetown)—Rich gold quartz opened in stope above main tunnel level. Copper-lead ore of stope being extracted. Quartz hanging-wall considered worthless until accidentally broken into and found to contain free gold. Side of stope 12 ft. high and 40 ft. long of shipping grade. Stope will be drawn and quartz mined.

### Dolores County

RICO-ARGENTINE (Rico)—New compressor building being constructed.

RICO MILLING CO. (Rico)—Force of 25 men employed on development with satisfactory results. New equipment to be installed to hasten development.

### Gilpin County

RARE ORES CO. (Rollinsville)—New mill now treating 50 tons per day will be increased to 75 tons daily.

HAMILTON & CO. (Central City)—Milling ore now being treated. Recent ore shipment returned $75 per ton.

### Lake County

M. E. C. (Leadville)—Satisfactory progress in sinking this shaft at head of East 8th St.

GARBUTT (Leadville)—Manager John Cortellini has planned a 250-ton cyanide plant for the large orebody opened in this Breece Hill property.

FORTUNE (Leadville)—New lease for two years granted on portion of mine below Yak tunnel; royalties between 15 and 50% for $10 to $100 ore. Some ore developed.

ALLEGHENY (Leadville)—Recently leased by W. E. Bowden. Shaft, being retimbered to 500 ft., will be sunk 300 ft. and new electric hoist installed. Adjoins the McCormick.

PROGRESSIVE (Leadville)—Warren F. Page, who is opening this old Fryer Hill property, has cleaned out and repaired shaft to 280 ft. Old workings being reopened. Diamond drilling may be undertaken if no large orebodies are found exposed.

ALLRIGHT (Leadville)—Lessees on this Poverty Flat property opened large body of iron-manganese ore recently. Ore said to assay 25% manganese, 30% iron and is low in silica and phosphorus. Will be shipped to Pueblo steel plant. Discovery stimulated development in this part of district. A second discovery of iron-manganese ore was made on 250-ft. level of Jason mine. Ore is lower grade than that of Allright, but shoot is of large size; stope opened to over 19 ft. in width in places.

### Ouray County

WAHNAKAH (Ouray)—Developing in milling-grade ore. Results in mill satisfactory.

KENO (Ironton)—Lessees opened shoot of shipping ore. Owned by Ouray Smelting and Refining Co.

OURAY TUNGSTEN MINING CO. (Ouray)—Incorporated to work Dunsmore group of tungsten claims, south of town. Tunnel being driven to cut vein at depth of 100 ft.

### Park County

BLACK BARNETT (Alma)—This Buckskin Gulch property will be reopened.

GOLD WAVE (Alma)—Peterson interest in this property sold to Hyndman Bros., of Fairplay.

HOCK HOCKING (Alma)—Purchased machinery of old Morning Star mill on Mt. Bross; installing same in new building at tunnel portal on south side of Mosquito Gulch. Mine development satisfactory.

### Summit County

RILLA (Breckenridge)—Contract let to drive east and west on Witch Hazel vein. Much low-grade ore developed in this vein. Equipped with rock drills and electrically driven compressor.

PIONEER CONSOLIDATED (Breckenridge)—Power line of Colorado Power Co. will be extended from Jessie mine to ground recently purchased, and mine equipment installed for extensive development.

### Teller County

PORTLAND (Victor)—Mill at Independence being remodeled and extended.

LAST DOLLAR (Victor)—Charles Walden has leased this Bull Hill mine and is improving the equipment.

QUEEN BESS (Cripple Creek)—Shipment of 27 tons from this Tenderfoot Hill property recently netted $2,100 to lessee operating through 750-ft. level of Molly Katherine shaft.

## IDAHO

### Shoshone County

OPTION ON DOUGLAS MINE, in Pine Creek section, held by Anaconda Copper Mining Co. reported extended for six months, though developments are proving satisfactory.

GOLD HUNTER (Mullan)—Faulted orebody picked up on 1,200-ft. level.

SILVER CABLE (Mullan)—Engineers of the Anaconda company, which has an option on this property, have completed their examination.

FEDERAL MINING AND SMELTING (Wallace) — Net profits for quarter ended July 31 were $268,287 after charging off $64,007 for depreciation; shipped 38,972 tons of concentrates and crude ore as against 31,844 tons in previous quarter when profits were $290,891. Strike reported in extension of No. 6 tunnel of Morning mine near Mullan; discovery is north of Morning vein and is regarded as new vein; shoot 20 ft. wide and high in zinc. Developments at Iron Mountain mines unsatisfactory and operations suspended.

IDORA (Wallace)—This company's mill in the Beaver Creek section, used jointly by the Idora and Tuscumbia mines, will be operated two 10-hr. shifts as ore is accumulating faster than it can be handled in 12 hr. Mill was turned over to Tuscumbia leasers for two weeks on Sept. 11 to clean up accumulation of ore. Increased development has followed decision of Oregon-Washington Railroad and Navigation Co. to build branch railroad up Beaver Creek to connect with Ray-Jefferson mill. E. L. Latta, superintendent of Idora and Charles E. Mallette, secretary and manager.

## MICHIGAN

### Copper

VICTORIA (Victoria)—Copper-bearing rock encountered on 29th level west of shaft.

LAKE (Lake)—Force being added to and production will be increased during coming month.

MASS CONSOLIDATED (Mass)—Mining selectively about 12 ft. of the 100-ft. Butler lode and obtaining rock averaging about 15 lb. of copper per ton; decidedly profitable under present conditions.

LAKE MILLING, SMELTING AND REFINING (Point Mills)—Now running five stampheads, two on Allouez rock, two on Isle Royale and the fifth on Superior and Hancock Consolidated.

CALUMET & HECLA (Calumet)—Production of Calumet & Hecla and subsidiaries for August was as follows: Calumet & Hecla 6,603,418 lb.; Ahmeek, 2,173,439; Allouez, 870,758; Centennial, 207,486; Isle Royale, 1,199,162; La Salle, 109,032; Osceola, 1,625,498; Superior, 192,463; Tamarack, 513,441; White Pine, 426,152 lb. copper First unit of C. & H. leaching plant is running satisfactorily, and it is expected in about two months to be treating 2,000 tons daily. This would give an annual production of 10,000,000 lb. of copper at a cost below that of the average Lake mine.

### Iron

AT QUINNESEC, the St. Clair company is drilling the old McKenna homestead. Some shallow drilling done there years ago.

CASTILE (Wakefield)—Two 500-gal. high-lift motor-driven pumps purchased; will pump against head of 1,250 ft.

OHIO (Michigamme)—Mine will work all winter—first time in years. Double present working force will be required.

FORBES (Iron River)—Much water entered workings during recent heavy rain. One miner drowned; water collected in a pit and broke through.

CHAMPION (Beacon)—Some of ore will be shipped from stockpile this fall. Mine idle several years. About 150,000 tons on surface. Track being put in shape.

HOLMES (Ishpeming)—Shaft will soon be bottomed. Headframe almost completed. Headframe will be 145 ft. high. Both hard and sofe hematites will be mined so there are pockets and chutes on two sides. Mining will start in winter. Shipments to be made next year.

## MINNESOTA

### Mesabi Range

LEONIDAS (Eveleth)—Mine working one shift. Closed several months. Deepest property on the range.

GENOA (Sparta)—This property flooded when strike started. All water is now removed and operations resumed.

FRANTZ (Buhl)—St. Clair Exploration Co. working two drills for Consumers Mining Co. Property idle since 1906. Some ore is known to exist.

ST. JAMES (Aurora)—Operations resumed here; was first mine closed when strike started. Two shifts are working. Over 250 men employed; wages $2.90 per day.

HULL-RUST (Hibbing)—Shipping a larger tonnage during present season than ever before and will set new record for the range. Nine steam shovels working in pit. Shipments in 1913 were 3,400,000 tons.

KERR (Hibbing)—This open-pit property, upon which stripping was finished a few weeks ago, has shipped its first ore. The pit is ½ mi. long and about 600 ft. wide; orebody rich with shallow overburden. Two shovels in pit at present.

GRANT (Buhl)—Mine started shipping steadily Sept. 13. A Jones & Laughlin property stripped by Butler Brothers. Its shipments have had big effect on state, lease records-172,000 tons of ore having been produced from state mines in one week.

SNYDER (Nashwauk)—This property, adjoining the Harrison, is being opened as a separate operation by Butler Brothers. A big Bucyrus shovel of 370 tons weight is stripping property. The development of this mine, together with other important work, is making Nashwauk one of the large mining centers of the Mesabi Range.

## MISSOURI

### Joplin District

BABCOCK (Joplin)—Completed shaft sinking after penetrating 24 ft. of good ore.

MERCHANTS (Miami)—Will start shaft on lease north of city; just completed fifth drill hole; 14 ft. good ore.

LUCKY 'LEVEN (Springfield)—Incorporated for $200,000 to develop 20-acre lease in Oklahoma section of field.

ANDREW (Galena)—New mill, completed on Martin land, will start during coming week. Drilled 18 holes showing ore from 55 to 120 ft.

PIOKEE (Picher, Okla.)—Spending $10,000 drilling lease adjoining Picher mines. Twenty-one holes down so far, ore in almost all, with assays from 5 to 23% blende.

JONES (Joplin)—Small company from Pittsburg, Kan., operating only coal mine in district on Mexico-Joplin land, north of Joplin. Have 5-ft. vein of soft coal at 30 ft.

EMPIRE ZINC (Galena)—The 6x15-ft. three-compartment shaft (largest in district) is down 90 ft. In broken ground; expect hard ground in another 10 ft. Shaft will go to 280 ft.

SUNNY SOUTH (Joplin)—New mill built at Thoms Station by Bilger & Montgomery has started. Mining at 140 ft., soft, timbering ground. Test at custom mill averaged 4%.

BELCHIC & McDONALD (Saginaw)—Drilling on 40-acre lease of St. Paul Mining Co.'s land where lead was mined 40 years ago. Three holes now completed show calamine from 75 to 100 ft.

SCOTT, PHELPS & SCOTT (Aurora)—Planning installation of first oil engines in Aurora camp at property north of town where shaft is now being sunk to 275 ft. Framework for mill being cut from timber near tract.

### Southeastern Missouri

MISSOURI COBALT CO. (Fredericktown) — Old buildings being razed to make room for new plant.

ST. JOSEPH LEAD CO. (Herculaneum) — Extensive improvements contemplated during coming year. William Allen Smith, manager.

## MONTANA

### Lewis and Clark County

HIGH-GRADE COPPER ORE struck in Looby mine, Grass Valley district, west of Fort Harrison, near Helena. Under lease and bond to Cruse company which will sink to 200 ft.

SCRATCH GRAVEL (Helena)—Shaft now down 500 ft., the greatest depth yet attained in Scratch Gravel district. At shaft bottom, vein is 6 ft. wide with 10-in. pay streak. Four carloads of ore shipped to smelters in August netted $14,000.

### Mineral County

INTERMOUNTAIN (Iron Mountain)—Initial dividend of ½c. per share announced for Oct. 20. Shipped five cars, valued at $8,500, to British Columbia Copper Co.'s Greenwood smeltery in August.

### Silver Bow County

NORTH BUTTE (Butte)—W. J. Stone, station tender at Speculator, fatally injured Sept. 11, being struck on head by a piece of timber while standing at the 400-ft. station.

BUTTE-DETROIT (Butte)—Will resume operations on large scale at Ophir mine. New machinery being installed and mill is being remodeled. Mine is in southern section of district and was large producer of rich silver ore. New company plans to exploit mine chiefly for its zinc ores.

## NEVADA

### Esmeralda County

GRANDMA CONSOLIDATED (Goldfield)—Heavier hoisting equipment now installed at new three-compartment shaft. Sinking resumed.

REA COPPER CLAIMS (Goldfield)—Shaft now down 300 ft.; crosscutting for vein. Lateral work at this level to determine plans for future development.

LOS ANGELES SULPHUR CO. (Goldfield)—Shipped three cars per week; sulphur content about 80%. A few days' delay occasioned recently by deposit catching fire. Property is two miles from Cuprite.

ATLANTA MINES CO. (Goldfield)—Footwall crosscut on 1,750-ft. level has cut vein, believed to be extension of one worked on 1,500-ft. level, Grizzly Bear. Encouraging assays obtained and drifting started.

GOLDFIELD CONSOLIDATED (Goldfield)—After about 3 weeks trial run, management announces recent conversion of plant to flotation treatment not entirely satisfactory under present conditions. Will revert to former cyanide treatment pending placing of additional settling and filtering capacity. In July, net realization was $30,016 from 26,700 tons; operating cost $5.62.

### Humboldt County

LOVELOCK QUICKSILVER MINES CO. (Lovelock)—New furnace about completed; 200 tons ore on dump awaiting treatment.

SEVEN TROUGHS COALITION (Seven Troughs) — Completely unwatered. Little damage resulted from flooding of workings. Expect to resume production during month.

### Lander County

PLUMAS-GOODWIN (Battle Mountain)—This group, 12 mi. southeast in Galena district, purchased by Breitung & Co., Ltd., 11 Pine St., New York, who will undertake further development.

### Nye County

TONOPAH ORE PRODUCTION for week ended Sept. 9 was 8,134 tons valued at $172,292 compared with 9,872 tons for week previous. Producers were: Tonopah Belmont, 2,445

tons; Tonopah Extension, 2,200; Tonopah Mining, 1,500; West End, 765; Jim Butler, 700; Rescue-Eula, 206; Halifax, 161; miscellaneous, 157 tons.

EARLY BIRD (Manhattan)—D. McFarland has joined James H. Nelson in lease and will soon make shipment.

WALL (Manhattan)—Wittenburg & Mushett and Tonopah men have leased this group near the Manhattan Summit.

ORIGINAL MANHATTAN (Manhattan)—Ray & Kryder, lessees, are developing considerable tonnage of low-grade ore and are considering a mill.

MUSTANG (Manhattan)—Train & Chase lease has reached incline depth of 225 ft., in rich ore. Another milling of high-grade ore will be made soon.

REORGANIZED WHITE CAPS (Manhattan)—Mill tests indicate 90% extraction at cost of $3.75 per ton. Roaster ordered. Mine showings continue favorable.

TONOPAH EXTENSION (Tonopah)—Quarterly dividend of 15c. per share declared. Sinking of Victor shaft resumed with 1,800-ft. level as the objective.

UNION AMALGAMATED (Manhattan)—Recent developments satisfactory, especially in the old Bath lease where oreshoot is opened from 250-ft. level to the 500.

WITTENBURG & MUSHETT (Manhattan)—In Big Pine, orebody reported found having been faulted easterly about 70 ft. Mill is again operating, after extensive overhauling.

WEST END (Tonopah)—Plans to reopen and deepen old Ohio-Tonopah shaft for further development of western area. Shaft is on California claim about due south of Extension No. 2 shaft; present depth 750 ft.

TONOPAH BELMONT (Tonopah)—Quarterly dividend of 12½c. per share amounts to approximately $187,500. Relinquished bond on Bull Moose property, near Beatty, where crew of about 10 men have been engaged in development for last six months.

## UTAH

### Beaver County

PALOMA (Milford)—Development in progress on 400 level, and in sinking shaft. Fifteen men working.

BONNEVILLE (Milford)—Development of property 12 mi. east of Milford undertaken by C. A. Cline. Copper-bearing rock opened.

BEAVER COMBINATION (Milford)—Recently started work from 200-ft. shaft sunk by Dan Ferguson. Electric hoist and compressor installed. Twelve men working. Property north of Moscow.

### Box Elder County

TUNGSTEN ORE being developed and mined at Bovine by Ogden men.

### Juab County

TINTIC SHIPMENTS for the week ended Sept. 8 were 181 cars, by 21 shippers.

EUREKA HILL (Eureka)—Machinery from old mill sold to Salt Lake machinery firm; included 600-hp. engine, crushers, stamps, etc.

IRON BLOSSOM (Silver City)—Working in north end where new copper ore is being developed on 1,200 level. Notice received that smelters will accept only limited tonnage of siliceous ore.

EAGLE & BLUE BELL (Eureka)—Station at 1,875-ft. level completed; drifting into orebody cut in sinking. Shipping about 50 tons daily coming from three different places. Ore showing in 25-ft. sump below 1,875-ft. level.

### Salt Lake County

MICHIGAN-UTAH (Alta)—Two cars daily being shipped.

SECRET MINING & MILLING (Alta)—Contract let for 200 ft. of work on lower tunnel. Now in 75 ft.

EMMA COPPER (Alta)—Two diamond drills being used to prospect for continuation of faulted orebodies of old Emma.

REED'S PEAK (Salt Lake City)—Block of ground on tunnel level leased to L. G. Schwalenburg. Property near head of Big Cottonwood.

BIG COTTONWOOD CONSOLIDATED (Salt Lake City)—Main tunnel in 630 ft. and daily progress of 5 ft. being made. New bunkhouse and building for machinery completed. J. E. Johnson, manager.

### Summit County

PARK CITY SHIPMENTS for the week ended Sept. 8 amounted to 2,571,110 lb. by seven shippers.

PARK CITY MINES (Park City)—Connections made on 700 level with raise from 900. Six inches of ore running well in gold and silver found. Shipment expected soon.

THREE KINGS (Park City)—Sinking below 500 shows increase in mineralization. Winze down 70 ft., and fissure widened from 18 in. to 4 ft. Small air hoist recently installed at winze; objective is contact of limestone with underlying Ontario quartzite.

JUDGE MINING & SMELTING (Park City)—Good progress being made in construction of zinc plant at Deer Valley. Wedge furnaces being erected. Material for leaching tanks, crushing machinery, etc., beginning to arrive. Expects plant to be treating 35 to 40 tons daily by first of year, producing about 15 tons of spelter.

### Tooele County

TUNGSTEN ORE being shipped from Deep Creek region, reached from Wendover on Western Pacific R.R. The Seminole controlled by Wilson brothers of Salt Lake City has made shipment. Tungsten occurs as scheelite.

## WASHINGTON

### Stevens County

COLUMBIA COPPER (Turk)—Ore is being taken by auto truck to Great Northern Ry. for shipment to Consolidated Mining and Smelting Co.'s plant at Trail, B. C.

## WISCONSIN

### Zinc-Lead District

TIFFANY ZINC (Platteville)—Foundations laid for 150-ton mill at Potosi.

OLIVER (Shullsburg)—Shipments of zinc concentrates from Mulcahy mine begun, first consignment of three cars going to Cherryvale, Kan.

WISCONSIN ZINC (Platteville)—Extensive drilling has proved strong orebody on Copeland lease at Shullsburg; formerly operated by the Lake Superior Mining Co.

UTT-THORNE (Platteville)—Lawrence mill at Cuba City was destroyed by fire; Utt-Thorne, owners, will buy low-grade ore and continue operating roasting plant at Benton.

## CANADA

### British Columbia

BUTTE ENGINEERS are examining the Tasso mines on the west coast of the Queen Charlotte Islands. Mines are owned by James E. Corlett, of Seattle, but worked at present by Thomas E. Young, of Victoria.

GRANBY CONSOLIDATED (Vancouver)—Has optioned the Swede and the Last Chance groups on Queen Charlotte Islands, near Lockport, and has commenced diamond drilling. O. B. Smith and E. J. Conway, of the Granby company also looked over the Ikeda mine at the south end of the Islands.

STANDARD SILVER-LEAD (Silverton)—Strike in upper tunnel on Alpha claim more important than first anticipated; may be one of best orebodies developed in mine. Monthly dividend of $50,000 declared for October, making $500,000 so far this year.

### Ontario

COSTELLO (Goodfish Lake)—Prospect shaft being sunk.

LA BELLE KIRKLAND (Kirkland Lake)—Will diamond-drill property.

PORCUPINE CROWN (Timmins)—Struck an important new vein at 800 ft.

PLATT (Porcupine)—Under option to the Coniagas, of Cobalt; will be diamond-drilled.

LAKE SHORE (Kirkland Lake)—Will issue 150,000 shares of treasury stock to provide funds for mill.

INTERNATIONAL NICKEL (Port Colborne)—New refining works will cover 23 acres; cost estimated at over $3,000,000.

CROWN RESERVE (Cobalt)—Vein running 5 to 7 in. opened on 700-ft. level, stated to carry 5,000 oz. to the ton.

WEST DOME (South Porcupine)—Ordered $35,000 worth of new machinery. Three new veins indicated by diamond drilling.

TRETHEWEY (Cobalt)—Shareholders' meeting to consider sale of mine to Northern Customs Concentrator postponed to Sept. 29.

ANKERITE (Porcupine)—Under option to Coniagas, of Cobalt; has granted six months' extension. New contract let for further diamond drilling.

DOME LAKE (South Porcupine)—Increasing capacity of mill to 200 tons a day. No announcement made of developed tonnage. Stock has been fluctuating widely.

NIPISSING (Cobalt)—During August ore was mined of estimated value of $203,898 and bullion from Nipissing and customs ore shipped of estimated net value of $226,341.

MILLER LAKE O'BRIEN (Gowganda)—Has made most striking discovery in northern Ontario; new vein on 350-ft. level in one place shows 39 in. of 3,000-oz. silver ore.

McKANE (Kirkland Lake)—Vein encountered in crosscutting on 300-ft. level shows 31 ft. of ore, being largest orebody so far found in Kirkland Lake district. Runs about $12 per ton.

BEAVER (Cobalt)—In developing lower contact, 242 ft. of crosscutting has been done at 1,600-ft. level, encountering 2 small veins similar in character to those cut above the diabase sill.

LORRAIN CONSOLIDATED (South Lorrain)—Julius Cohen, engineer in charge, reports shaft put down 40 ft. since mine reopened. Vein has left shaft dipping to south about 5° from vertical.

LITTLE NIPISSING (Cobalt)—At this property now being operated by a Detroit syndicate, the workings have been dewatered below the 100-ft. level. Inspection of old stopes shows considerable low-grade ore.

McINTYRE (Schumacher)—New machinery has been ordered, including 500-hp. compressor, electric hoists and crushing and hauling equipment. An electric sub-station is to be built on north side of Pearl Lake.

BUFFALO (Cobalt)—The 600-ton flotation will placed in operation. About 100 tons of ore from mine will be treated daily and 500 tons of tailings. There are accumulated tailings amounting to 300,000 tons, the silver content of which is estimated at 1,600,000 oz.

DOME EXTENSION (South Porcupine)—Under option to Dome. Suspended drilling operations in deep hole designed to cut extension of main Dome orebodies. The hole turned in strike and dip, and capacity of machine was reached before ore was cut.

## BOLIVIA

ARAMAYO FRANCKE MINES, LTD. (Chorolque)—Tin production at Chorolque has been decreasing and tunnels are being driven at greater depth in hopes of finding sulphides; good tungsten ore, however, has been developed in this section. In Tasna, good results obtained in workings of bismuth and tungsten. In the Chocaya section expectations have been fully realized in production both of silver and tin; option on this group for £275,000 to an American syndicate, that contemplated purchasing the neighboring Oploca company also, lapsed on the failure of the latter negotiations, and was not renewed.

## BRITISH GUIANA

GOLD EXPORTS for the half year ended July 1 were 15,966 oz. fine or $330,022 in value; a decrease of $212,772 from 1915. The exports of diamonds were 6,695 carats, valued at $51,964; an increase of 6,224 carats over last year.

# The Market Report

## Metal Markets

**NEW YORK—Sept. 20**

A very large business was done both in copper and in lead and in the latter there was a sharp advance in price. The spelter market became dull and toward the closed showed signs of a reactionary tendency.

## Copper, Tin, Lead and Zinc

**Copper**—Again a very large business was done, the sales of which we had reports amounting to about 60 million pounds, which was larger than in the previous week. The business was done in large blocks, and to the major extent was with domestic brassmakers and sheet-rollers, whose product, however, is largely destined ultimately for export. It is noteworthy that the producers and agencies who were the largest sellers in the previous week were the smallest sellers this week, and vice versa. Such changes from week to week reflect more or less ability to make deliveries, etc. There was a fair volume of business in copper for delivery in 1916, but the largest business was for delivery in the first quarter of 1917, and some sales of round lots were made for delivery during the first half of 1917 and during the second quarter of 1917, several agencies taking such business. There was a wide range of prices, according to the delivery, sales for early delivery being reported at 27¾@28¼c., while contracts for late deliveries were accepted on the basis of 25¾c., net cash, New York, a large volume of business being reported at about that figure. The average realized on all the business of which we had reports was about 26¾c., and we quote the market for the week at 26½@27c., which does not reflect weakness as compared with the previous week, but simply that the major market had become for a later delivery on the average.

The important foreign business, to which we referred last week, was still pending at the time of our going to press, but there was understood to be a possibility of its consummation on Thursday, and at the same time an expectation that it might be further delayed.

**Copper Sheets** are nominal at 37.5c. per lb. for hot rolled and 38.5c. for cold rolled. Copper wire is 32@32½c. per lb. for large lots at mill.

**Copper Exports** from Baltimore for the week included 224,043 lb. copper and 26,228 lb. brass to England; 269 tons brass to Italy; 3,000,000 lb. copper to Russia.

**Copper Exports** from the port of New York, as reported at the Custom House for the month up to Sept. 20 were 16,310 gross tons.

**Visible Stocks of Copper** in Europe on Sept. 15 are reported as follows: Great Britain, 4,484; France, 2,634; afloat from Chile, 1,550; afloat from Australia, 3,000; total, 11,668 gross tons, or 26,136,320 lb. This is an increase of 154 tons over the Sept. 1 report.

**Tin**—There was scarcely any change in the price of this metal during the week. For the first three days the market was practically idle. On Sept. 18 and 19 a small business in future was done, the market for near-by tin continuing dull.

Supplies of Banka and Billiton tin in August were 1,164 gross tons. For the year 1916 they are estimated at 17,740 tons. The stock in the hands of the Netherlands Trading Co. on Aug. 31 was 936 tons.

**Lead**—As we forecasted last week, the A. S. & R. Co. was forced to advance its price, which it did by raising to 6.75c., New York, on Sept. 15. Independent producers immediately asked and realized more, and the A. S. & R. Co. advanced again on Sept. 19 to 7c., while independent producers had sold at 6.90c. on the morning of that day. The St. Louis market was also very strong, there being a stiff demand for chemical lead, which at certain times during the week sold on even terms with the New York market.

**Spelter**—Considerable business was done in the early part of the week, including some for export, but then the market flattened out, previous experiences being repeated, viz., a disappearance of buyers after the price has risen to 9c. On Sept. 20 business was done in considerable volume at a lower price than had prevailed previously, and the market exhibited a distinctly softer tendency.

Exports from Baltimore for the week included 403,116 lb. spelter to England.

**Spelter Exports** from New York as reported at the Custom House for the month up to Sept. 20 were 6,750 gross tons.

**Zinc Sheets** are in steady demand and business is fair. Quotations are unchanged at $15 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

## Other Metals

**NEW YORK—Sept. 20**

**Aluminum**—Demand continues good while supplies are not heavy. It is difficult to fill large orders for any early delivery. Prices are strong at 61@63c. per lb. for No. 1 ingots, New York.

**Antimony**—This market was dull and somewhat weaker. Producers reported that it required considerable skill to land orders. There was a wide range of prices. We quote 11@12½c.

**Quicksilver**—There was a fair business at unchanged price, $75, New York. San Francisco reports, by telegraph, $75@77½, market steady.

**Nickel**—Demand is good both from domestic and export business. Prices are firm and unchanged at 45@50c. per lb. for ordinary forms, according to size of order. A premium of 5c. per lb. is charged for electrolytic nickel.

Imports at Baltimore for the week included 475 tons nickel ore from Noumea, New Caledonia.

**Minor Metals**—Current quotations for **Bismuth** are $3.15@3.30 per lb., New York—**Cadmium** is quoted at $1.30@1.50 per lb.—**Cerium**, electrolytic, is sold at $8@9 per lb.—**Cobalt Metal** is quoted at $1.25 per lb.—**Magnesium** is steady, with sales at $3.75@4 per lb. for 99% pure.—**Selenium** is from $3 up to $5 per lb., according to size of order.

## Gold, Silver and Platinum

**Gold**—Further arrival of $10,000,000 gold from Ottawa is reported this week. Making a total of $307,000,000 received on British account since May 1. More is reported coming.

Gold output of the Kolar goldfield in Mysore, India, for August is reported at 45,361 oz.; for the eight months ended Aug. 31 it was 357,238 oz., or $7,384,110; a decrease of 13,968 oz. from last year.

**Platinum**—This market was unchanged at $85. Producers report an increasing demand from jewelry manufacturers.

Platinum production in Russia in 1915 is estimated by a recent report at 215 poods—or 103,200 oz.—a decrease of 83 poods from 1914. Platinum production of Colombia is estimated at 19,000 oz., against 17,500 oz. in the preceding year.

**Silver**—The market continues steady with fair inquiry from the other side—sufficient to absorb the moderate offering going forward weekly. The opinion is expressed by London authorities that: "In view of probable continuance of coinage orders and encouraged by the favorable monsoon, indicating a possible demand for the bazaars, we see no reason to expect any setback at present, and even higher prices may be seen."

Mexican dollars were quoted in New York Sept. 14 at 52⅝@55⅝c.; Sept. 15 at 52⅝@55⅝c.; Sept. 16 at 52¾@55½c.; Sept. 18 at 53@56c.; Sept. 19 at 52⅞@55½c.; Sept. 20 at 52¾@55c. per peso.

## Zinc and Lead Ore Markets

**Joplin, Mo., Sept. 16**—Price quotations per 2,000 lb.: Blende, high, $65.70; 60% zinc, premium ore, $65; medium grades, $65@60; low, $55. Calamine, per ton 40% zinc, $45@30. Average selling price, all grades of zinc, $57.43 per ton. Lead base price $70@65 per ton 80% metal contents. High price, $71.90. Average selling price, all grades of lead ore, $67.60 per ton.

Shipments of the week: Blende, 8,509 tons; calamine, 181 tons; lead, 1,103 tons. Value, all ores, the week, $573,600; the year to date, $27,105,230.

During the past week the railroads requisitioned some coal shipments, but tonight reports indicate a settlement of wage scale in the Kansas coal fields, ending the probability of a strike further injuring the zinc mining industry. The shipment of the week is the largest since April, and with but a slight increase in output will lower the reserve stock. Further heavy buying for next week's delivery greatly enhances prospects for a winter ore market better than during the past summer.

**Platteville, Wis., Sept. 16**—Quotations for the district are according to the following figures: Base price per 2,000-lb. ton for material assaying 60% zinc is $56 for premium ore down to $50 for medium grade. For material assaying 80% lead the base price per 2,000-lb. ton is $71. Shipments for the week were 2,798 tons of zinc ore, 28 tons of lead ore, and 570 tons of sulphur ore. For the year to date, the figures are, 87,467 tons of zinc ore, 3,059 tons of lead ore, and 20,790 tons of sulphur ore. Shipped during the week to separating plants, 4,523 tons of zinc ore.

SILVER AND STERLING EXCHANGE

| Sept. | Sterling Exchange | Silver New York, Cents | Silver London, Pence | Sept. | Sterling, Exchange | Silver New York, Cents | Silver London, Pence |
|---|---|---|---|---|---|---|---|
| 14 | 4.7575 | 68⅛ | 32⅛ | 18 | 4.7575 | 68⅛ | 32 11/16 |
| 15 | 4.7575 | 68 | 32⅛ | 19 | 4.7575 | 68⅛ | 32⅛ |
| 16 | 4.7575 | 68¼ | 32⅛ | 20 | 4.7575 | 68⅛ | 32⅛ |

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

| Sept. | Copper Electrolytic | Tin Spot. | Lead N. Y. | Lead St. L. | Zinc St. L. |
|---|---|---|---|---|---|
| | 26½ | | 6.65 | 6.55 | 9.00 |
| 14 | @27 | 38⅜ | @6.75 | @6.60 | @9.25 |
| | 26½ | | 6.70 | 6.55 | 9.00 |
| 15 | @27 | 38⅜ | @6.80 | @6.65 | @9.25 |
| | 26½ | | 6.75 | 6.65 | 9.00 |
| 16 | @27 | 38½ | @6.85 | @6.85 | @9.25 |
| | 26½ | | 6.75 | 6.65 | 9.00 |
| 18 | @27 | 38½ | @6.90 | @6.85 | @9.25 |
| | 26½ | | 6.90 | 6.85 | 9.00 |
| 19 | @27 | 38½ | @7.00 | @6.95 | @9.25 |
| | 26½ | | | 6.90 | 8.87½ |
| 20 | @27 | 38⅜ | 7.00 | @6.95 | @9.12½ |

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only St. Louis price is given, St. Louis being basing market. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

| Sept. | Copper Standard Spot | Copper Standard 3 Mos. | Copper Electrolytic | Tin Spot | Tin 3 Mos. | Lead Spot | Zinc Spot |
|---|---|---|---|---|---|---|---|
| 14 | 117 | 113 | 133 | 170½ | 171½ | 30½ | 54 |
| 15 | 116 | 112 | 134½ | 170½ | 171½ | 30½ | 54 |
| 16 | .... | .... | .... | .... | .... | .... | .... |
| 18 | 116 | 112 | 135½ | 170½ | 171½ | 30½ | 55 |
| 19 | 116 | 112 | 135½ | 171½ | 172 | 30½ | 56 |
| 20 | 116½ | 113 | 135½ | 172½ | 173 | 30½ | 56 |

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. Copper quotations for electrolytic are subject to 3% discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜ cents.

### OTHER ORES

**Manganese Ore Exports** from British India in the quarter ended June 30, 1916, were: United States, 12,326 gross tons; Italy, 7,300; France, 12,570; Great Britain, 121,013; total, 153,209 tons. In the corresponding quarter of 1915 the exports were 56,072 tons.

Imports at Baltimore for the week included 23,250 tons manganese ore from Brazil.

**Pyrites** production in the Urals in Russia in 1915 was 39,400 gross tons. The pyrites deposits are situated not far from Ekaterinburg.

**Tungsten Ore**—The market was dull and a trifle weaker. We quote $16½@17 per unit.

**Antimony Ore**—Unchanged at $1@1.10 per unit.

## Iron Trade Review

### NEW YORK—Sept. 20

While domestic orders have not increased to any great extent, there is much inquiry for material for next year's delivery, both for home consumption and for export.

With cooler weather the mills are doing better work and are gaining back the ground lost last month. They are, as a rule, still far behind their orders, and could hardly come out even in six or eight months, even if no more orders should be received. Under these circumstances premiums on any early deliveries needed must be expected.

Export demand is strong and steady, both for semi-finished and finished steel. In home buying structural steel is rather slow again, but plates and shapes for shipbuilding are in very strong demand.

The heaviest item of business in the past week is in the placing of orders for 500 miles of line pipe by the Standard Oil Co., and of 150 miles by Oklahoma companies. This will require a large tonnage of plates, still further increasing the demand.

The Interstate Commerce Commission this week is hearing protests from manufacturers against the proposed increase of rates on iron and steel to seaboard points. This increase would do away with the special rates made on export goods and would make export material pay local rates to the seaboard. The larger increases proposed are to points west of Pittsburgh.

The pig-iron market is active and strong. There have been large transactions in basic pig both in the East and the West. Foundry iron also is in good demand. Both Northern and Southern furnaces report large sales and higher prices.

The Thomas Iron Co., Hokendauqua, Penn., has received an offer of $3,500,000 for its property—consisting of blast furnaces and iron ore property—from a Philadelphia syndicate said to be made up of large steel interests. The offer was referred to a committee. The Thomas Iron Co. is one of the oldest and largest makers of merchant iron.

**Exports of Iron and Steel** and their products from the United States for the seven months ended July 31 are reported as follows, the first line giving the tonnage of those products reported by weight; the second line the value of machinery and the third line the total value of all exports:

| | 1915 | 1916 | Changes |
|---|---|---|---|
| Tonnage exports, tons. | 1,676,485 | 3,116,234 | I. 1,439,749 |
| Machinery, value..... | $67,959,822 | $123,406,983 | I. $55,447,161 |
| Total value. | 174,940,645 | 442,240,120 | I. 267,244,475 |

The exports far exceeded those of any previous year. The increase in the total value of exports was 152% this year. Imports of articles reported by weight for the seven months were 124,636 tons in 1915 and 145,309 in 1916; increase, 20,673 tons.

Exports from Baltimore for the week included 1,107 tons steel scrap, 2,911 tons steel billets and 34 tons wire to Italy; 848,960 lb. pig iron and 1,624,330 lb. steel billets to France; 1,311,640 lb. pig iron, 317,517 lb. steel pipe, 604,800 lb. wire, 681,722 lb. nails, 15,627,094 lb. steel billets, rods, blooms and bars to Great Britain.

### PITTSBURGH—Sept. 19

Steel production has been increased somewhat, with more favorable weather, and most of the mills expect to make new tonnage records in October, a month always marked by favorable weather for outputs. The mills have fallen farther behind in shipments, with the curtailed output of July and August and at the best will have to break many promises made for delivery this year. The Carnegie Steel Co. expects to make 1,000,000 tons of ingots next month, which would constitute a new record. Some new openhearths are being completed at Farrell and Clairton, with a new mixer at the latter plant.

The steel market continues to present an appearance of quietness. In some branches, as in sheets and tinplates, the mills have not opened their books for next year, while they are filled for this year. In rails they are filled for practically all of next year. In other lines they are filled as far ahead as they usually sell, and thus there is not much disposition to buy or sell. Nevertheless the total of obligations on mill books does not seem to diminish materially.

Steel prices are very strong all along the line and may even be said to show a slight advancing tendency in general. Woven wire fence has been advanced 1½ points to 60% off, an advance of about $2.50 per ton. Predictions are made that the tinplate price for next year will be $5.50, against $3.60 for the past season, but some observers do not expect more than $5 per box.

**Pig Iron**—Sales of basic have hitherto been confined to this year's delivery, but in the past few days there has been a considerable tonnage, 25,000 to 50,000 tons, sold for first half 1917, generally at $18 25, Valley, representing an advance of 25c. For the furnaces to sell for an additional half-year at only 25c. advance, however, does not bear out predictions lately made of a large advance for pig iron, and one buyer is understood to have secured iron at only a few cents above $18, Valley. The buying of foundry iron continues, with furnaces showing a slight disposition to quote higher prices. Export demand continues for bessemer, while some export inquiry is now in the market for basic. We quote basic up 25c., other quotations unchanged: Bessemer, $21@21.50; basic, $18 25@18.50; foundry and malleable, $18.50@18.75; forge, $18@18.25, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

**Steel**—It is now understood that the Carnegie Steel Co.'s price for fourth-quarter on quarterly adjustment sheet-bar contracts will be $2 higher than for third-quarter, when the nominal price was $40, with various adjustments with special customers down to $35. In the open market there are only occasional offerings, and the market is considered almost nominal at $45@50 for billets of sheet bars, bessemer or openhearth. A Cleveland mill was recently offering steel for first half 1917 at $46, mill, but is understood to be out of the market now. Rods are $55@60 per ton.

### FERROALLOYS

Exports from Baltimore for the week included 485 tons ferromanganese and 650 tons spiegeleisen to Italy—an unusual item.

**Ferrosilicon**—Bessemer ferrosilicon varies from $30 for 9% up to $41 for 16%, all per ton at furnace. High grade, 50%, is $86@89 at furnace. Several contracts are reported placed at these prices for the first half of next year.

**Spiegeleisen** is unchanged, ordinary 20% being quoted at $40@45 per ton at furnace; 25 to 30% is held at $55@65, according to grade and size of order.

**Ferromanganese**—British makers have taken cognizance of offerings of contract ferromanganese by domestic makers at $165 and thereabouts and are meeting the competition. Even this figure is understood to have been shaded slightly in one or two cases. We quote prompt and contract at $165@170 per ton.

Imports of ferromanganese in July were 5,341 gross tons in 1915, and 40,162 in 1916; increase, 34,821 tons.

Imports at Baltimore for the week included 3,275 tons ferromanganese from Middleboro, England.

### IRON ORE

A few belated buyers of Lake Superior ore have made their appearance and quotations have been made them of $5.20 per ton for Old Range bessemer, an advance of 75c.; and of $4.20 for non-bessemer, an advance of 50c. over this season's price.

Wild tonnage has been chartered for the balance of the season at rates varying from 85c. to $1 per ton from the head of the Lakes.

The decision of the Interstate Commerce Commission on iron-ore rates from Lake Erie ports to furnaces is a complex one and will involve many changes. It will not take effect until Apr. 1, 1917, so that it will not affect the work of this season.

The commission's new project is that every ore rate shall be divided into three parts, each part representing a detail of the service. At present rates are stated so as to include the whole service of taking the ore from the rail of the vessel to the trestle of the furnace company. The proposal, approved by the commission, is that the unified service shall be treated as three distinct operations, for each of which a charge is to be made. The first is to be a flat rate of 6c. per gross ton for unloading from ship to car. The second is for the rail haul from the dock to the furnace plant inclosure and the third is to cover the placing of the car on the unloading trestle.

Dock ore at present bears a rate of from 8c. to 10c. greater than direct ore. The rate on dock ore is also to be stated so as to show its components. The railroads which own the unloading devices are to charge 16c. for taking the ore out of the ship and depositing it in a stock pile and 10c. for taking it from the stock pile to the car. That means a net increase of 16c. in dock ore that now pays 10c. more than direct ore and of 18c. in the case of ore that costs 8c. more than direct ore.

The groupings of Lake ports as points of origin and of furnace towns as groups of destination are also to be changed. The destination groups and distances are to be as follows: Youngstown to include furnace points from 50 to 74 mi. from the lake; Leetonia, 75 to 99 mi.; Midland, 100 to 124 mi.; Pittsburgh-Wheeling, 125 to 159 mi., and Monessen-Johnstown, 160 to 199 mi.

### COKE

Alabama coke trade has been active, with shipments to Texas and the Pacific Coast and some to Mexico. Standard furnace coke is quoted at $3.25@3.50 at ovens; foundry coke, $4.25 per ton.

Coke production in the Connellsville region week ended Sept. 9 is reported by the "Courier" at 384,374 net tons; shipments, 384,213 tons. Production was cut down by the Labor Day holiday.

**Connellsville**—Despite the advent of cooler weather, which was expected to improve labor conditions, coke has grown scarcer. Several sales of spot of a brand not generally regarded as standard have been made at $2.85, and as high as $3 is reported in one instance. The scarcity is of coke-making labor, there being a sufficient supply of miners, and indeed, there are now shipments of nearly 100,000 tons a week of raw coal from the strictly Connellsville region, chiefly for byproduct coking. Consumers are beginning to show some interest in first-half contracts, on which operators' views range from $2.75 to $3, or much above what furnaces expected to pay. We quote: Spot furnace, $2.85@3; contract, $2.75; spot and contract foundry, $3.25@3.50 per ton at ovens.

New South Wales Coal Production for two years past is reported as follows, in gross tons:

| | 1914 | 1915 | Changes |
|---|---|---|---|
| Coal mined.... | 10,390,622 | 9,449,008 | D. 941,614 |
| Coal exported.. | 5,868,033 | 4,668,394 | D. 1,199,639 |
| Coke made.... | 304,800 | 417,753 | I. 112,953 |
| Oil shale mined | 50,049 | 15,474 | D. 34,575 |

The number of persons employed in coal mining in 1915 was 17,959 on the average.

### SAULT STE. MARIE CANALS

The total tonnage of freight passing through the Sault Ste. Marie canals for the season up to Sept. 1 was: East bound, 44,121,701; west bound, 11,427,272; total, 55,548,972 net tons, an increase of 18,144,822 tons over 1915. Of the total traffic 4,145 vessels carrying 10,850,100 tons passed through the Canadian Canal; 11,261 vessels carrying 44,698,873 tons through the United States Canal. The total number of vessel passages was 15,406, showing an average cargo of 3,606 tons.

Mineral freights included in the totals were, in net tons except salt, which is given in barrels:

| | 1915 | 1916 | Changes |
|---|---|---|---|
| Anthracite.... | 1,274,174 | 1,305,594 | I. 31,420 |
| Bituminous coal..... | 6,552,627 | 9,158,100 | I. 2,605,473 |
| Iron ore..... | 25,962,787 | 37,867,562 | I. 11,904,775 |
| Pig and m'f'd iron..... | 118,360 | 116,272 | D. 2,088 |
| Copper..... | 79,254 | 64,709 | D. 14,545 |
| Salt, bbl..... | 393,853 | 465,455 | I. 71,602 |

The total freight tonnage in August was 14,031,262 tons. For the season iron ore was 68.2% and coal 18.8% of the total freight.

### NEW YORK—Sept. 20

The general market is steady and the demand for heavy chemicals is reported good, with prices generally steady and a good undertone.

**Arsenic**—Offerings are not large but supplies are pretty well taken up, and prices are steady and unchanged. Spot arsenic is quoted at $6@6.25 per 100 lb., according to size of order.

**Copper Sulphate**—Actual business is rather quiet just now, but prices are well held, though a little easier. Standard makes are $10.50@10.75 per 100 lb., according to size of order.

**Nitrate of Soda**—Reports from the west coast of South America are that freights are slightly lower, though vessels are not at all plentiful. Business here is fair, but prices are slightly easier at $2.95 per 100 lb. for both spot and futures.

**Sulphur**—The market continues strong with a heavy demand. High freight rates are still a factor. Quotations are $35 per ton, New York, for spot and $30 for futures.

Exports of sulphur from Japan for two years are reported as below, in pounds:

| To | 1914 | 1915 | Changes |
|---|---|---|---|
| Australia .... | 52,204,636 | 63,356,168 | I. 11,151,532 |
| India ..... | 2,111,053 | 10,524,868 | I. 8,413,815 |
| Russia ..... | 734,815 | 11,819,997 | I. 11,085,182 |
| Canada ..... | 3,975,658 | 11,586,428 | I. 7,610,770 |
| United States | 41,600,098 | 60,655,332 | I. 19,055,234 |
| Total ..... | 100,626,260 | 157,942,793 | I. 57,316,533 |

The production of sulphur was much restricted in 1914, but the year 1915 showed a large increase and the first half of 1916 showed a still greater gain.

**Sulphuric Acid**—Demand is good and prices are steady at $1 per 100 lb. for 60-deg. and $1.50 per 100 lb. for 66-deg. acid. Some concessions are said to have been made on large contracts for future delivery.

### Assessments

| Company | Delinq. | Sale | Amt. |
|---|---|---|---|
| Alta Silver, Nev. | Sept. 1 | Sept. 25 | $0.03 |
| Andes, Nev. | Oct. 11 | Nov. 1 | 0.02 |
| Beaver Gold, Utah | Aug. 19 | Sept. 16 | 0.01 |
| Beaver Mines, Utah | Sept. 30 | Oct. 21 | 0.0025 |
| Blue Star, Ida. | Sept. 25 | Oct. 21 | 0.02 |
| Bull Valley, Utah | Oct. 10 | Oct. 31 | 0.004 |
| Cash Boy, Nev. | Sept. 1 | Oct. 15 | 0.01 |
| Coal Creek, Ida. | Aug. 25 | Sept. 26 | 0.005 |
| Colonial, Ida. | Aug. 26 | Oct. 10 | 0.001 |
| Con. Virginia, Nev. | Sept. 29 | Oct. 20 | 0.05 |
| Crown Point, Utah | Sept. 16 | Oct. 10 | 0.005 |
| Eagle Mountain, Ida. | Oct. 2 | Nov. 4 | 0.001 |
| Exchequer, Nev. | Sept. 5 | Sept. 26 | 0.03 |
| Friend, Ida. | Aug. 26 | Sept. 16 | 0.002 |
| Great Bend, Nev. | Aug. 15 | Sept. 20 | 0.01 |
| Great Western, Nev. | Sept. 26 | Oct. 18 | 0.01 |
| Idaho-Nevada, Ida. | Sept. 14 | Oct. 14 | 0.002 |
| Jacket-C.Point-Belcher, Nev. | Aug. 14 | Sept. 7 | 0.05 |
| Leonora, Utah. | Sept. 27 | Oct. 16 | 0.005 |
| Old Veteran, Ida. | Sept. 9 | Oct. 7 | 0.002 |
| Paloma, Utah | Aug. 21 | Sept. 9 | 0.01 |
| Phedora, Ida. | Aug. 29 | Sept. 29 | 0.001 |
| Rio Grande Grubstake, Nev. | Sept. 22 | Oct. 31 | 0.002 |
| Royal Copper, Ida. | Sept. 2 | Oct. 2 | 0.001 |
| Sandstorm Kendall, Nev. | Aug. 22 | Sept. 26 | 0.01 |
| Santaquin Chief, Utah | Sept. 11 | Sept. 21 | 0.0025 |
| Santaquin King, Utah | Sept. 11 | Sept. 21 | 0.0025 |
| Sells, Utah | Sept. 21 | Oct. 7 | 0.06 |
| Sierra Nevada, Nev. | Oct. 12 | Nov. 2 | 0.10 |
| Silver Pick, Nev. | Sept. 25 | Oct. 30 | 0.01 |
| Smuggler, Utah | Sept. 20 | Oct. 18 | 0.005 |
| Spearhead, Nev. | Oct. 2 | Nov. 2 | 0.01 |
| Springfield Tunnel, Calif. | Aug. 15 | | 0.05 |
| Syndicate, Utah | Sept. 18 | Oct. 14 | 0.0015 |
| Tarbox, Mont. | Sept. 28 | Oct. 28 | 0.005 |
| Tonopah-Bonanza, Nev. | Sept. 19 | Oct. 16 | 0.01 |
| Tyler, Ida. | Sept. 12 | Oct. 12 | 0.0015 |
| Umatilla, Nev. | Sept. 18 | Oct. 24 | 0.0025 |
| Uvada, Nev. | Oct. 9 | Oct. 26 | 0.02 |
| West Toledo, Utah | Sept. 12 | Oct. 3 | 0.01 |
| Whale, Utah. | Sept. 5 | Sept. 25 | 0.05 |
| Wonderful, Ida. | Aug. 30 | Sept. 20 | 0.001 |

### Stock Quotations

| SAN FRANCISCO Sept. 19 | |
|---|---|
| Name of Comp. | Bid. |
| Alta | .05 |
| Andes | .10 |
| Best & Belcher | .06 |
| Bullion | .01 |
| Caledonia | .35 |
| Challenge Con. | .07 |
| Confidence | .15 |
| Cons. Imperial | .01 |
| Con. Virginia | .10 |
| Gould & Curry | .03 |
| Hale & Norcross | .10 |
| Jacket-Cr. Pt. | .06 |
| Mexican | .16 |
| Occidental | .70 |
| Ophir | .22 |
| Overman | .06 |
| Savage | .13 |
| Seg Belcher | .03 |
| Sierra Nevada | .32 |
| Union Con. | .69 |
| Utah Con. | .01 |
| Belmont | 4.25 |
| Jim Butler | .90 |
| MacNamara | .05 |
| Midway | .21 |
| Mont.-Tonopah | .21 |
| North Star | .16 |
| Rescue Eula | .23 |
| West End Con. | .72 |
| Atlanta | .09 |
| Blue Bell | ‡.01 |
| Booth | .11 |
| C.O.D. Con | .02 |
| Comb. Frac | .06 |
| D'field B.B. | .02 |
| D'field Daisy | .02 |
| Jumbo Extension | .34 |
| Round Mountain | .37 |
| Sandstorm Kendall | .03 |
| Silver Pick | .17 |
| Central Eureka | .07 |
| Argo | .07 |
| Ariz. Central | .15 |
| Big Jim | 1.21½ |
| Lazy Boy | .10 |
| Oatman No. Star | ‡.10 |
| Tom Reed | 2.00 |
| United Eastern | 3.75 |
| United Western | .08 |

| LONDON Sept. 6 | |
|---|---|
| Alaska-Mexican | £1 6s 3d |
| Alaska Tre'dwell | 5 7 6 |
| Burma Corp. | 3 15 0 |
| Cam & Motor | 0 11 6 |
| Camp Bird | 0 8 0 |
| El Oro | 0 10 0 |
| Esperanza | 0 12 0 |
| Mexico Mines | 3 15 0 |
| Nechi, pfd. | 0 13 0 |
| Oroville | 0 16 9 |
| Santa Gert'dis. | 0 12 0 |
| Tomboy | 1 2 0 |

| SALT LAKE Sept. 19 | |
|---|---|
| Name of Comp. | Bid. |
| Alta Con. | .25½ |
| Black Jack | .07 |
| Cardiff | 7.00 |
| Colorado Mining | .16 |
| Crown Point | .04½ |
| Daly-Judge | 8.00 |
| Emma Con. | 1.25 |
| Gold Chain | .17 |
| Grand Central | .62 |
| Iron Blossom | 1.47½ |
| Lower Mammoth | .05 |
| May Day | .07½ |
| Opohongo | .01 |
| Prince Con. | 1.35 |
| Seven Troughs | .03 |
| Silver King Coal'n | 3.00 |
| Silver King Con. | 3.55 |
| Sioux Con. | .11 |
| So. Hecla | 1.90 |
| Uncle Sam | .03 |
| Wilbert | .06 |
| Yankee | .16 |

| COLO. SPRINGS Sept. 19 | |
|---|---|
| Acacia | .03 |
| Cresson | 6.48 |
| Doctor Jack Pot | .08½ |
| Elkton Con. | .17 |
| El Paso | .44 |
| Findlay | .03½ |
| Gold Sovereign | .05 |
| Golden Cycle | 2.25½ |
| Granite | .74½ |
| Isabella | .21½ |
| Jack Pot | .05½ |
| Jerry Johnson | .04 |
| Mary McKinney | .30 |
| Portland | 1.71½ |
| Vindicator | 1.99 |

| TORONTO Sept. 19 | |
|---|---|
| Adanac | .25 |
| Bailey | .09 |
| Chambers Ferland | .21 |
| Coniagas | 4.70 |
| La Rose | .59 |
| Peterson Lake | .22 |
| Right of Way | .05½ |
| Seneca Superior | .25 |
| T. & Hudson Bay | 60.00 |
| Temiskaming | .63 |
| Wettlaufer-Lor | .11 |
| Dome Exten. | .36 |
| Dome Lake | .56 |
| Foley O'Brien | .60 |
| Hollinger | 7.00 |
| Jupiter | .30 |
| McIntyre | 1.44 |
| Newray | .65 |
| Porcu. Crown | .71 |
| Vipond | .39 |
| West Dome | .37 |

| N. Y. EXCH. Sept. 19 | |
|---|---|
| Name of Comp. | Clg. |
| Alaska Gold M. | 14 |
| Alaska Juneau | 7¾ |
| Am.Sm.&Ref.,com | 107¾ |
| Am. Sm. & Ref., pf. | 114¾ |
| Am. Sm. Sec., pf. A | 95 |
| Am. Sm. Sec., pf. B | 85 |
| Am. Zinc | 42½ |
| Am. Zinc, pf. | 78½ |
| Anaconda | 90¾ |
| Batopilas Min. | 1⅞ |
| Bethlehem Steel | 559 |
| Bethlehem Steel, pf. | 129 |
| Butte & Superior | 64½ |
| Chile Cop. | 20 |
| Chino | 53½ |
| Colo. Fuel & Iron | 54½ |
| Crucible Steel | 94½ |
| Dome Mines | 24¾ |
| Federal M. & S. | 21 |
| Federal M. & S., pf. | 43½ |
| Great Nor., ore ctf. | 42½ |
| Greene Cananea | 49¾ |
| Homestake | 133 |
| Inspiration Con. | 61 |
| International Nickel | 48¾ |
| Kennecott | 52¾ |
| Lackawanna Steel | 85 |
| Miami Copper | 37½ |
| Nat'l Lead, com. | 70½ |
| National Lead, pf. | ‡110 |
| Nev. Consol. | 21½ |
| Ontario Min | 7 |
| Quicksilver | 3 |
| Quicksilver, pf. | 5 |
| Ray Con. | 24¾ |
| Republic I&S, com. | 67 |
| Republic I&S, pf. | 110 |
| Sloss-Sheffield | 57½ |
| Tennessee Copper | 25¾ |
| Utah Copper | 86 |
| U. S. Steel, com. | 108¾ |
| U. S. Steel, pf. | 120¾ |
| Va. Iron C. & C. | 54 |

| N. Y. CURB Sept. 19 | |
|---|---|
| Beaver Con. | .43½ |
| Buffalo Mines | .85 |
| Butte & N. Y. | 1½ |
| Butte C. & Z. | 6½ |
| Caledonia | .64 |
| Can. Cop. Corpn. | 1 1/16 |
| Cashboy | .06 |
| Cerro de Pasco | 39½ |
| Con. Ariz. Sm. | 1½ |
| Con. Coppermines | 2½ |
| Con. Nev.-Utah | 1/16 |
| Crystal Cop. | 1½ |
| First Nat. Cop. | 5½ |
| Florence | .76 |
| Goldfield Con. | .74 |
| Goldfield Merger | .07½ |
| Granite | .20 |
| Hecla Min | 5 1/16 |
| Howe Sound | 5 |
| Jerome Verde | 2 1/16 |
| Joplin Ore & Spel. | .50 |
| Kerr Lake | 4¼ |
| Magma | 17½ |
| Majestic | ⅛ |
| McKinley-Dar-Sa. | .65 |
| Mother Lode | .38½ |
| Nevada Hills | .22 |
| N. Y. & Hond. | 15½ |
| Nipissing Mines | 8¾ |
| Oro | .03 |
| Ray Hercules | 3½ |
| Rochester Mines | .50 |
| St. Joseph Lead | 16½ |
| Standard S. L. | 1½ |
| Stewart | .25 |
| Success | .38 |
| Tonopah | 5½ |
| Tonopah Ex. | 5½ |
| Tribullion | ¾ |
| United Zinc | 5½ |
| White Knob, pf. | 1½ |
| White Oaks | 5½ |
| Yukon Gold | 2 |

| BOSTON EXCH Sept. 19 | |
|---|---|
| Name of Comp. | Bid |
| Adventure | 3½ |
| Ahmeek | 105 |
| Algomah | 1½ |
| Alloues | 66 |
| Ariz. Com., ctfs. | 12¾ |
| Bonanza | .28 |
| Butte-Balaklava | 1½ |
| Calumet & Ariz. | 71½ |
| Calumet & Hecla | 555 |
| Centennial | 18 |
| Copper Range | 64 |
| Daly West | 2¾ |
| East Butte | 15¾ |
| Franklin | 8½ |
| Granby | 87¾ |
| Hancock | 13 |
| Helvetia | .25 |
| Indiana | 2½ |
| Island Cr'k, com. | 43 |
| Island Cr'k, pfd. | 90 |
| Isle Royale | 30¾ |
| Keweenaw | 6½ |
| Lake | 13½ |
| La Salle | 4¼ |
| Mason Valley | 3½ |
| Mass | 14½ |
| Mayflower | 2¾ |
| Michigan | 3½ |
| Mohawk | 89¾ |
| New Arcadian | 7 |
| New Idria | 14½ |
| North Butte | 20¾ |
| North Lake | 2 |
| Ojibway | 1¼ |
| Old Colony | 1¾ |
| Old Dominion | 67 |
| Osceola | 91 |
| Quincy | 89½ |
| St. Mary's M. L. | 87 |
| Santa Fe | 2½ |
| Shannon | 9½ |
| Shattuck-Ariz. | 30 |
| So. Lake | 5¾ |
| So. Utah | 23 |
| Superior | 18½ |
| Superior & Bost. | 5½ |
| Tamarack | ‡37½ |
| Trinity | 6¾ |
| Tuolumne | .50 |
| U. S. Smelting | 73½ |
| U. S. Smelt'g, pf. | 52 |
| Utah Apex | 4 |
| Utah Con | 13½ |
| Utah Metal | ‡7¾ |
| Victoria | 3¼ |
| Winona | 5 |
| Wolverine | ‡48 |
| Wyandot | 1½ |

| BOSTON CURB Sept. 18 | |
|---|---|
| Bingham Mines | 9¾ |
| Boston Ely | 1½ |
| Boston & Mont. | .88 |
| Butte & Lon'n Dev. | .58 |
| Calaveras | 6 |
| Calumet-Corbin | .03½ |
| Chief Con. | 1 3/16 |
| Cortez | .35 |
| Crown Reserve | .57 |
| Davis-Daly | 1 3/16 |
| Eagle & Blue Bell | 1 1/16 |
| Houghton Copper | 1½ |
| Iron Cap Cop., pf. | 5½ |
| Mexican Metals | .36 |
| Mines of America | 2½ |
| Mojave Tungsten | 4½ |
| Nat. Zinc & Lead | 1 1/16 |
| Nevada-Douglas | 1 1/16 |
| New Baltic | 2 |
| New Cornelia | 16½ |
| Ohio Copper | .28 |
| Oneco | .85 |
| Raven Copper | ‡.07 |
| Rex Cons. | .27 |
| Rilla | .16 |
| United Verde Ext. | 39½ |

‡Last Quotations.

### Monthly Average Prices of Metals

SILVER

| Month | New York | | | London | | |
|---|---|---|---|---|---|---|
| | 1914 | 1915 | 1916 | 1914 | 1915 | 1916 |
| January | 56.572 | 48.855 | 56.775 | 26.553 | 22.731 | 26.960 |
| February | 57.506 | 48.477 | 56.755 | 26.573 | 22.753 | 26.975 |
| March | 58.067 | 50.241 | 57.935 | 26.788 | 23.708 | 27.597 |
| April | 58.519 | 50.250 | 64.415 | 26.958 | 23.709 | 30.662 |
| May | 58.175 | 49.915 | 74.269 | 26.704 | 23.570 | 35.477 |
| June | 56.471 | 49.034 | 65.024 | 25.948 | 23.267 | 31.060 |
| July | 54.678 | 47.519 | 62.940 | 25.219 | 22.597 | 30.000 |
| August | 54.344 | 47.163 | 66.083 | 25.979 | 22.780 | 31.498 |
| September | 53.290 | 48.680 | | 24.260 | 23.591 | |
| October | 50.654 | 49.385 | | 23.199 | 23.925 | |
| November | 49.082 | 51.714 | | 22.703 | 25.094 | |
| December | 49.375 | 54.971 | | 22.900 | 26.373 | |
| Year | 54.811 | 49.684 | | 25.314 | 23.675 | |

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

| Month | New York Electrolytic | | London Standard | | London Electrolytic | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| Jan. | 13.641 | 24.008 | 60.756 | 88.083 | 65.719 | 116.167 |
| Feb. | 14.394 | 26.440 | 63.494 | 102.667 | * | 133.167 |
| Mar. | 14.787 | 26.310 | 66.152 | 107.714 | * | 136.000 |
| April | 16.811 | 27.895 | 75.096 | 124.319 | * | 137.389 |
| May | 18.506 | 28.625 | 77.600 | 135.457 | * | 152.522 |
| June | 19.477 | 26.601 | 82.574 | 112.432 | 95.333 | 137.455 |
| July | 18.796 | 23.865 | 76.011 | 95.119 | 91.409 | 125.500 |
| Aug. | 16.941 | 26.120 | 68.673 | 110.283 | 82.333 | 126.304 |
| Sept. | 17.502 | | 68.915 | | 85.250 | |
| Oct. | 17.686 | | 72.601 | | 88.000 | |
| Nov. | 18.627 | | 77.744 | | 93.273 | |
| Dec. | 20.133 | | 80.773 | | 100.43 | |
| Year | 17.275 | | 72.532 | | | |

TIN

| Month | New York | | London | |
|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 |
| January | 34.260 | 41.825 | 156.550 | 175.548 |
| February | 37.415 | 42.717 | 176.925 | 181.107 |
| March | 48.426 | 50.741 | 180.141 | 193.609 |
| April | 47.884 | 51.230 | 166.225 | 199.736 |
| May | 38.790 | 49.125 | 162.675 | 196.511 |
| June | 40.288 | 42.231 | 167.636 | 179.466 |
| July | 37.423 | 38.510 | 167.080 | 168.357 |
| August | 34.389 | 38.565 | 151.440 | 169.870 |
| September | 33.125 | | 152.625 | |
| October | 33.080 | | 151.554 | |
| November | 39.224 | | 167.670 | |
| December | 38.779 | | 167.000 | |
| Av. year | 38.590 | | 163.960 | |

LEAD

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| January | 3.729 | 5.921 | 3.548 | 5.826 | 18.606 | 31.167 |
| February | 3.827 | 6.246 | 3.718 | 6.164 | 19.122 | 31.988 |
| March | 4.053 | 7.136 | 3.997 | 7.375 | 21.883 | 34.440 |
| April | 4.221 | 7.630 | 4.142 | 7.655 | 21.094 | 34.368 |
| May | 4.274 | 7.463 | 4.182 | 7.332 | 20.347 | 32.967 |
| June | 5.932 | 6.936 | 5.836 | 6.749 | 25.170 | 31.011 |
| July | 5.659 | 6.352 | 5.531 | 6.185 | 24.611 | 28.137 |
| August | 4.656 | 6.244 | 4.520 | 6.088 | 21.946 | 29.734 |
| September | 4.610 | | 4.490 | | 23.151 | |
| October | 4.600 | | 4.499 | | 23.994 | |
| November | 5.155 | | 5.078 | | 26.278 | |
| December | 5.355 | | 5.266 | | 28.807 | |
| Year | 4.673 | | 4.567 | | 22.917 | |

SPELTER

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| Jan. | 6.386 | 16.915 | 6.211 | 16.745 | 30.844 | 89.810 |
| Feb. | 8.436 | 18.420 | 8.255 | 18.260 | 39.819 | 97.762 |
| Mar. | 8.541 | 16.846 | 8.360 | 16.676 | 44.141 | 95.048 |
| April | 10.012 | 16.695 | 9.837 | 16.525 | 49.888 | 99.056 |
| May | 14.781 | 14.276 | 14.610 | 14.106 | 68.100 | 94.217 |
| June | 21.208 | 11.752 | 21.038 | 11.582 | 100.614 | 68.591 |
| July | 19.026 | 8.925 | 18.856 | 8.755 | 97.250 | 50.750 |
| Aug. | 12.781 | 8.730 | 12.611 | 8.560 | 67.786 | 51.587 |
| Sept. | 13.440 | | 13.270 | | 67.841 | |
| Oct. | 12.800 | | 12.596 | | 66.536 | |
| Nov. | 15.962 | | 15.792 | | 88.409 | |
| Dec. | 15.391 | | 15.221 | | 89.400 | |
| Year | 13.230 | | 13.054 | | 67.553 | |

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

PIG IRON IN PITTSBURGH

| Month | Bessemer‡ | | Basic‡ | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1915 | 1916 | 1915 | 1916 |
| January | $14.59 | $21.60 | $13.45 | $18.78 | $13.90 | $19.70 |
| February | 14.55 | 21.16 | 13.45 | 18.93 | 13.90 | 19.51 |
| March | 14.55 | 21.81 | 13.45 | 19.20 | 13.95 | 19.45 |
| April | 14.55 | 21.65 | 13.45 | 18.95 | 13.95 | 19.45 |
| May | 14.61 | 21.78 | 13.60 | 19.11 | 13.83 | 19.58 |
| June | 14.70 | 21.95 | 13.67 | 18.95 | 13.77 | 19.34 |
| July | 14.94 | 21.95 | 13.91 | 18.95 | 13.68 | 19.20 |
| August | 16.01 | 21.95 | 15.31 | 18.95 | 14.75 | 19.25 |
| September | 16.86 | | 15.95 | | 15.70 | |
| October | 16.95 | | 15.96 | | 15.80 | |
| November | 17.57 | | 16.47 | | 17.20 | |
| December | 19.97 | | 18.44 | | 18.95 | |
| Year | $15.82 | | $14.76 | | $14.95 | |

‡As reported by W. P. Snyder & Co.